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Vertical Bending Rolls.

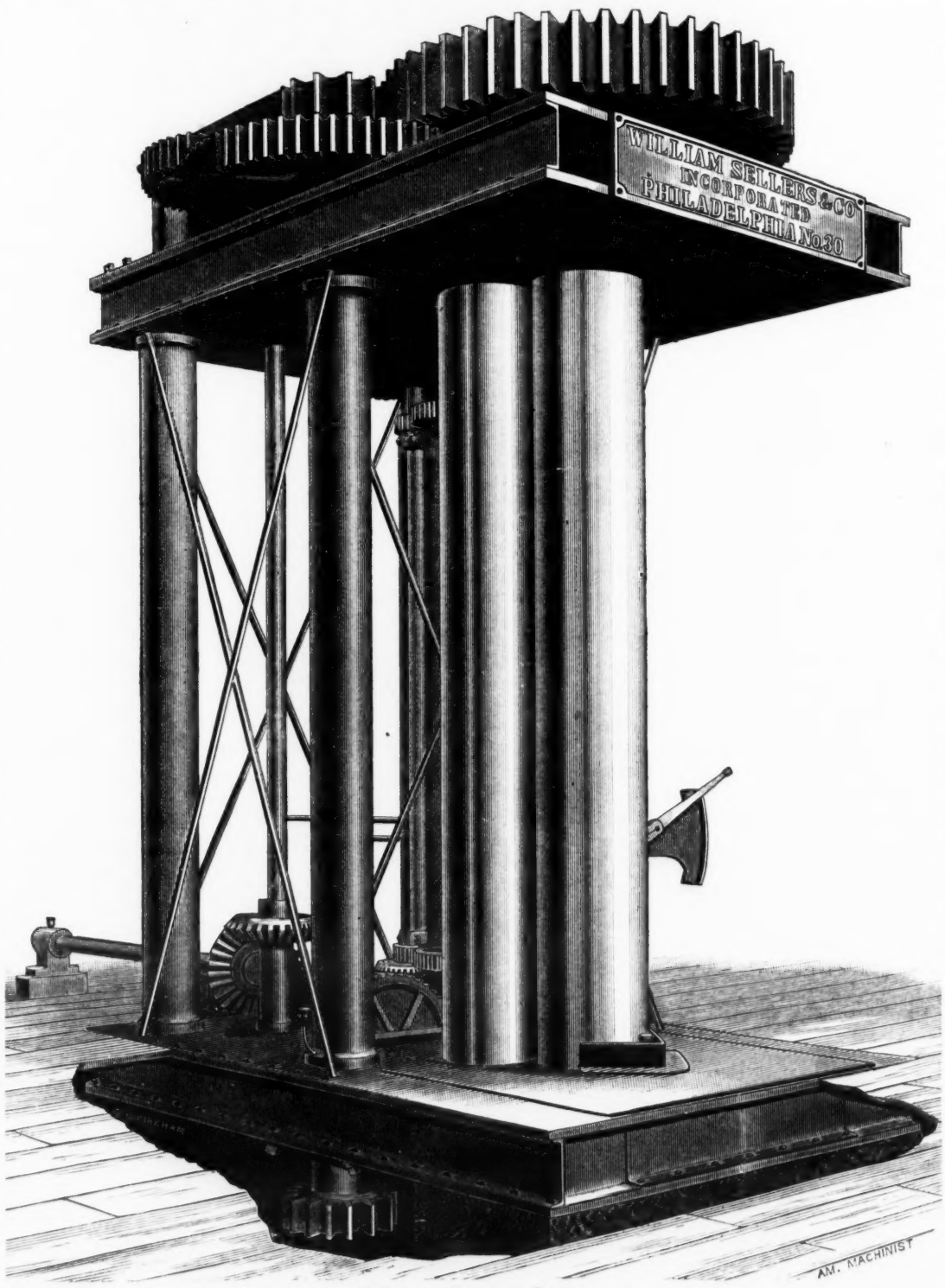
We present herewith an engraving of a set of vertical bending rolls built by William Sellers & Co., of Philadelphia, for the Newport News Shipbuilding and Dry Dock Company. They are fully capable of bending a steel plate 10 feet wide, 1½ inches thick.

The rolls are of forged steel, the bending roll 18 inches diameter, and the two side rolls 15 inches diameter; all carried in heavy plate housings, and so united as to embody great strength, and at the same time leave the front of the machine unobstructed for the free curvature of the plate. All three rolls are driven by a pair of independent reversing engines. The bending roll is the principal driving roll, and the side rolls are adjustable to and from the bending roll by another pair of independent engines controlled by convenient levers, and so arranged that the two ends of the rolls may be adjusted together or independently in either direction. The driving wheels at the bottom of the side rolls are of cast steel, very heavy and strong, while the bending roll carries at its upper end a large spur gear wheel over 5 feet in diameter, and about 4 inches pitch by 11 inches face, driven by a steel pinion with ample bearings on both sides. The bending roll with its upper bearing and driving wheel can be withdrawn by an overhead crane for the removal of flues. All of the rolls are carried in cast-iron bearings.

The machine bears evidence of much careful study, and differs from the usual type of such machines in a number of important features.

The usual plan of driving by gearing the side rolls only in a three roll machine, leaving the middle roll to be carried by the plate, has been abandoned, and in this machine all three rolls are driven positively by gearing so powerful as to greatly increase the capacity of the machine, and reduce the number of passes necessary to bend a heavy plate. Hitherto the problem of driving all the rolls at the same peripheral speed has been embarrassed by the calendering action developed in the passage of a curved plate. To avoid this action, and at the same time relieve the driving gear of unnecessary strain, there is provided in the train of gearing for the side rolls, a positive clutch with sufficient lost motion to allow for the maximum effect of calendering. The work of driving the plate through the rolls is thus thrown altogether or chiefly on the large and powerful gearing, which drives the middle roll, and although the pinions on the side rolls are thus relieved entirely, or in part, of the work of driving, they are always in readiness to assist, should the friction of the middle roll on the plate be insufficient to carry it through.

It will be seen that the rolls are carried in steel plate housings united by four cast-iron columns, which arrangement, whilst embodying ample strength, leaves the entire front of the machine unobstructed to the free curvature of the plate, and thus avoids another serious defect in vertical rolling machines as heretofore built. Contrary to the usual practice, the side rolls are made adjustable in the housings instead of the middle roll. This departure enables the principal train of gearing for the middle roll to be arranged in a more substantial manner, while the side rolls, which have comparatively little to do, can be adjusted for bending straight or in wind.



VERTICAL BENDING ROLLS.

The Evolution of a Drafting-room.

BY WALTER B. SNOW.

The successful man is by no means simply the man of original ideas, but the man who understandingly incorporates with those ideas the ideas and experiences of others. The man who never reads, who never asks questions, who never looks into the world about him to see what others are doing, will soon find himself belonging to an age that is past, no matter how great his natural genius.

It may be, then, that the experience of one concern in the development and organization of its drafting-room system may prove of benefit to others who are struggling with a solution of the same matter.

Eight years ago, in the drafting-room of the aforesaid concern, the conditions were these: The work was in the hands of two men, one old and experienced in the school of our fathers, but growing feeble day by day; the other just taken from the pattern shop to help out in the drafting-room.

As monuments to the zeal of previous but departed draftsmen, there existed these various lots of drawings:

First. A splendid set of inked paper drawings and tracings of a certain line of engines. They were carefully drawn, accurately dimensioned, and numbered consecutively, thus, 16—1, 16—2, etc. The number 16 indicated the drawer; for some unknown reason thus chosen, although it might as well have been 10 or 12. But the drawings were not all of a size, although fully two-thirds of them approached very nearly to a certain standard. Various blue prints of these drawings with soda corrections innumerable were to be found. The practically standard size drawings, tracings and blue prints were filed respectively by themselves in portfolios. A consecutive list of these drawings was kept in a small book by itself.

Second. About seventy-five heavy tin-covered pasteboard cards, substantially of the same size, upon which were mounted paper tracings of various engines. They were well shellaced and numbered consecutively, and, although they formed excellent shop drawings, yet, as their originals had never been worked up, damage to them was almost irreparable. These, when not in use, were kept in a drawer in which they did not fit, and no record of them whatever was to be found.

Third. About fifty tracings of all sizes of large shafts, connecting rod centers, etc., forming a set of forging drawings, and numbered consecutively with the letter F prefixed to each number. They were all preserved in a small portfolio, and recorded in a small book—separate from the first.

Fourth. A similar set of forging drawings, but in the shape of pen and ink sketches on note size paper. Each had been copied in a letter book, but had never been indexed. They were preserved in a large envelope.

Fifth and last came the department "Legion." Innumerable drawings of all conceivable sizes, shapes, colors, materials and qualities, without numbers, seldom having dates, and often lacking definite titles. To their sacred use was devoted a case of drawers about four feet wide by seven feet long; even with such a size, some drawings had to be folded. Certain sets of paper drawings well shellaced and preserved had been collected into groups, punched and eyeletted, tied together with shoe-strings, and thus

formed into the most inconvenient and unwieldy books of drawings. Tied in the same bunch would be drawings three feet by five feet, and four inches by six inches. A feature of this age and department was the substitution of the word "new" for any further indication of the date of a drawing. It consequently was nothing surprising to find four or five drawings titled in this manner, "New valve for 8x12 upright engine," although more likely the word "upright" would be omitted, still further confusing the matter. No claim was ever made for originality in this manner of designating the age of drawings. As might be expected, there was no list whatever of these drawings. In point of fact, many of them, left in pencil, had been simply studies, and from them later drawings had been made. Many original drawings were in the shop, mounted on massive boards, or tracings had been made, and possibly shellaced and mounted in the same manner. Blue prints were but little in use at the time.

Such was the condition as it was presented to the writer upon his first introduction. Naturally, immediate action in such a matter was impossible. Time was required to become acquainted with the drawings and the work, in order to judge of the best methods of future procedure, and to carefully cull out the useless drawings. As the large drawings were so numerous as to preclude any possibility of having them all reduced to standard sizes, and as there was only a distant hope of a card index, it was deemed best to classify, to some extent, the drawings as they were found. Accordingly separate drawers were set apart for such divisions as upright engines, cylinders up; upright engines, cylinders down; horizontal engines up to ten inch diameter; horizontal engines above ten inch diameter, fans, heaters, etc. At the same time a consecutive or chronological list was started. In all the classification, this one thought was kept in mind, that when a card index was finally completed, it would make no real difference in what drawer a certain drawing might be, as it would be found with equal facility by the index, but until the index was completed, the classification would be of considerable advantage in readily locating the drawings. There consequently arose a *series* of drawer numbers, whereas, if there had been no previous drawings in existence, they might all have been filed consecutively.

All new drawings were now made in pencil on paper, carefully dimensioned, and while still in pencil were traced on tracing cloth, and the necessary blue prints made. As the original paper drawings have proved to be of very little value (generally of the most service as a ready means of changing for new tracings) the omission of the inking has been a matter of decided economy.

In time, the old and absolutely useless drawings of the "old school" were destroyed, and those preserved were numbered consecutively, independently of size, in their respective drawers. The drawing was designated by the drawer number followed by a dash, and the consecutive number of the drawing in the given drawer. All new working drawings were made of a standard size, 18x26 inches, and filed in the proper drawers under the new classification.

In this connection was inaugurated a system of records of the engines shipped, with the name of the party, number of order and of engine, and a complete list of all drawings required in its construction. At the end of eight years, when orders are beginning to come in for repairs, this record is proving itself of almost untold value, as by its aid orders for single parts can be immediately and accurately filled.

In course of time it was found that greater economy and clearness would result, if certain drawings could be made larger than the standard 18x26-inch sheet. Accordingly the additional size of 24x36 inches was chosen, and all drawings of this size were designated by the prefix letter C, as it left the letter B for the designation of a possible intermediate size between 18x26 inches and 24x36 inches.

The adoption of this additional size also facilitated the systematizing work which was undertaken. All the old drawings, now numbered, but of various sizes, were either folded or trimmed to one of the two standard sizes. Those made 24x36 inches were all designated by C prefixed to the previous number. Thus 6—37 became C 6—37. The necessary cases of drawers were provided for these drawings, each drawer being one inch larger in each dimension than the drawings it contained. The drawers were two inches in depth, and provided at the back with 3-inch horizontal strips forming tops to the drawers, and serving to prevent the rolling up and catching of the drawers at the back. Handles with spaces for labels were used, and each drawer designated by the drawings it contained; thus 6—51 to 100, the regular holding capacity being fifty drawings Of course, the C size drawings were now separated from the small standard size drawings, all inconvenience being avoided by having the numbers in the record prefixed with the letter C, the same as the drawing.

It may seem strange that no designating letter should have been selected for the 18x26-inch drawings. In the first place, they were so numerous as to make such a proceeding the cause of much work, but furthermore their designation in this manner would in no way have simplified matters or made it easier to find them. Naturally, had the two sizes both been chosen at the same time, and before any drawings had been made and numbered, each size would have had a prefix letter.

The transition from the cumbersome and huge drawings was a pleasure indeed. There was no longer the turning over and over of the large drawings in the search for the small ones. All in a drawer were all of a size, and numerically and compactly arranged.

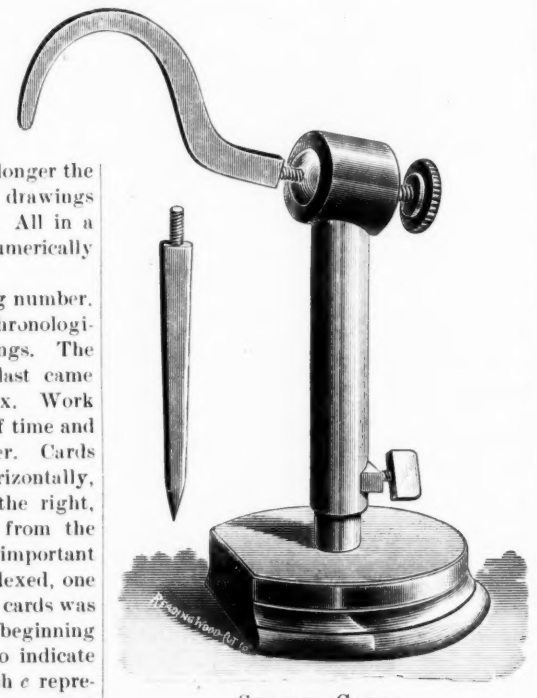
But with their rapidly increasing number, it became more difficult by the chronological records to find the desired drawings. The long-looked-for opportunity at last came for at least starting a card index. Work was really slack enough to allow of time and thought being put into the matter. Cards 3x5 inches were chosen, ruled horizontally, and with a single vertical line at the right, to separate the drawing number from the rest of the inscription. The most important classes of drawings were first indexed, one drawer at a time. A check on the cards was kept by placing small *cs* at the beginning of the title in the record book, to indicate that cards had been made out, each *c* representing a card, for some drawings comprised the separate details of several pieces. To further indicate under what heads or letters these were indexed, a double dot was placed in the book beneath the initial letter of each word that formed the leading word upon a card. Every card that had been made out could thus be readily located, so that corrections could easily be made. Whenever a drawing was made for a special party the address of the party, followed by the description of the drawing, was entered upon one card, while upon another or others would be all necessary entries for finding all that was represented upon the drawing. The growth of this index has been slow, as it was necessary not only to keep up with the regular work, but also to catch the work of years gone by. However, every new addition only made its usefulness and economy so apparent that it gave renewed encouragement to complete the index. As it now stands it is authority upon all subjects relating to the drawing-room.

One instance may be given as illustrative of its utility. Many sizes of hot air flue dampers have been required in the introduction of some of the work done by the house with which this drafting room is connected, and the question is often asked, Have we such and such a size damper? As all the dampers are indexed together in the order of their size, it requires but a few seconds to answer the question decisively. The writer knows by experience about how long it used to take before these drawings were indexed. This is only illustrative; the same thing occurs in a hundred cases. If ever there was a labor-saving device, it is the card index.

System in this line begot system in others. The work is now more discreetly assigned to the different draftsmen; that is, the particular qualifications of each are considered, and, so far as possible, only certain classes of work are given to certain men. In this way each becomes to a certain extent an expert or specialist in his particular line, and experience has shown that regular work can be turned out much more rapidly and correctly by this division of labor. Cheaper help for tracing is employed, and the more expensive men employed only on laying out or finishing up and dimensioning.

All drawings now pass through the hands of the chief draftsman before being blue printed, and the blue printing is placed entirely in the hands of a young man who makes prints only on written orders, and keeps a record of the disposition made of them.

The drawings received from outside parties are numbered, filed and indexed under the main title, ADDRESSES, DRAWINGS RECEIVED. For the engine department careful erection drawings are made of all engines, and upon each of these drawings is placed a list of all the drawings of the separate parts required to make up the complete whole. There is thus placed in the hands of the machinist a special index of all the



SURFACE GAUGE.

drawings relating to the machine he is building or setting up.

In many cases where slight changes in parts have been made, and it becomes necessary to change the tracings, two or three blue prints of the tracing are taken before the change is made, and each blue print marked "For Record." The tracing is then treated as desired, and given a new number, so that, although having the same title, it may not be confused with the blue prints. By means of the record of engines shipped, and a list upon the erection drawing, all possibility of confusion is avoided, and the drawing preserved from a long list of notes indicating changes upon engines of certain numbers.

As different engine parts, such as crank-pins, links, stuffing-boxes, valve connections, etc., have become standardized, they have been collected upon single standard drawings, and individually designated by letters, the entire drawing being numbered as usual. Reference on the erection drawing to a particular part, as a crank-pin, for instance, is then made in this manner: D on 3—178, and a long list of engine sizes upon the standard drawings is avoided by simply titling them, "Standard Crank-pins." Comprehensive tables giving general dimensions of certain pieces, as blower-boxes, have been made, so that a glance reveals the nominal size and principal dimensions of the box for any given size blower, and *vice versa*.

The aim has always been to standardize the work, so that, instead of having several jobs differ by just so little that a separate drawing is required for each, that they shall agree and be finer by a single standard drawing.

As a result of the standard sizes of drawings, great economy results on the materials used. The 18x26 stock cuts two sheets, and the 24x36 cuts one sheet wide from paper, tracing cloth or blue print paper 36 inches wide. There are no scraps of odd sizes to be used up in the spirit of economy.

The blue print paper is kept in a roll in a box having a narrow slit through which the paper is drawn, and cut off the exact lengths by a sliding knife. Tracing cloth is cut up by the roll in the same manner, a single person cutting up several weeks' supply in a remarkably short time. Standard size pasteboard rolls are bought and used for mailing, and in fact, at every turn, the economy of standard sizes is evident.

No progressive man can ever feel that the end is reached, and that there is no further opportunity for systematizing; but while there is still room for improvement in this drafting-room, yet, when its present condition is compared with its past, the end really seems almost within reach.

Surface Gauge.

The engraving presented on this page represents the effort of a machinist to produce a surface gauge different from others—a task of no small magnitude when the vast number of different gauges now on the market is considered.

The gauge consists of the usual base, from which rises a stem in the ordinary manner, and to this stem is fitted a sleeve, which can be adjusted to any desired height, and clamped by means of the thumb-screw shown near the bottom. At the top of this sleeve is a socket, in which a ball is placed, into which the scriber or pointer is tapped, and this ball can be clamped in position by means of the knurled screw at the back, a loose disk being interposed between the ball and the end of the screw. When changing from a height gauge to a scribing gauge it is necessary to remove the bent point and screw in the pointed one. It is made by W. H. Ermentrout, Reading, Pa.

In connection with the report of the Rapid Transit Commission, it has been claimed in some quarters that no electric motor has yet been devised that will draw trains at the necessary speed (30 miles per hour) and that it is doubtful if one can be built to do it.

This, of course, has roused the electricians, and they are strenuously insisting that it not only can be done, but that electric power is the only power worth considering in that work. One electrician has come out with a challenge to build such a motor, and to forfeit money if it does not do certain things, the skeptics to bear the expense of the experiments if it does. There is one painful void in all this, however. No mention is made of net efficiency.

The time may come when electricians will do as steam engineers have been doing for years, *i. e.*, guarantee to do certain work on a specified consumption of coal; but no electrician has yet arrived at that point, so far as we know.

A recent graduate of a technical school expresses the opinion that if all the graduates saw their way clear to follow the occupation they liked best, at least two-thirds of them would connect themselves in some way with matters pertaining to steam engineering. Whether this estimate is correct or not, there seems but little reason to doubt that there is a fascination in matters relating to planning, constructing and operating steam engines, that is likely to attract more than a proper share of technical graduates. There is probably more danger of overcrowding in that direction than in any other.

It is estimated that the travel between New York and Boston aggregates over 1,000,000 passengers a year.

Discussion of Papers at the Providence Meeting of Mechanical Engineers.

In our issue of June 18 we published the paper by F. A. Halsey on "The Premium Plan of Paying for Labor." This paper brought out more discussion than any other paper presented. As showing current thought in this direction, we publish, below, a considerable part of this discussion:

MR. JOHN T. HAWKINS: I am opposed to the premium plan. To pay by the day's work or by the hour's work is a better plan, if all will deal fairly. . . . The plan proposed is far below the piece-work plan in value. Mr. Halsey follows the plan in detail with his figures, and assumes a possible reduction of one-half the time in completing the required work. Worked out, this comes to a time when the manufacturer is getting his work thirty-five per cent. cheaper, and the workman is making fifty per cent. profit. Thus, if we concede to the workman a capacity upon the premium plan double that at piece-work, it would be unfair to the consumer. This leads to a monopolistic combination of workmen and employers, which would result in the starting of rival concerns. . . . The piece-work system furnishes the only relief.

MR. D. F. C. DAVIS: I have known several instances where the bonus plan was adopted, by which a certain amount of time was arrived at as being customary for certain work, and then cards were given out stating that half of the time saved would revert to the mechanic and half to the shop; and that established what might be considered a minimum amount of time that each job would be likely to require with the appliances then in hand. These shops that are doing this have arrived at what may be considered fair piece-work prices, and, after using that a little while, have dropped it as being too cumbersome, and come down to the simple piece-work plan. But by starting out with the bonus plan first, they avoided the necessity for such extensive cutting, and have gotten at fair piece-work prices by the bonus system. . . .

MR. WILLIAM O. WEBBER: I think Mr. Davis has rather hit the nail on the head. The successful piece-work system is largely in making your prices right in the first place, and I think that can be easily done by a manager who thoroughly understands his business. . . . We have found in the Erie City Iron Works, at Erie, Pennsylvania, that treating our men fairly has resulted not only to their advantage, but to ours. We have even had men come to us and say that the piece-work price for a certain piece of work was too much, comparing it with different pieces of a different size. We recently had a workman in our works come and say we were paying him a certain price for planing cylinders, and if we would give him a more modern planer, he would plane those pieces for twenty per cent. less. That was certainly a fair proposition on his part, and we immediately took it up. I think that the piece-work system is the only one that will ever be successful in that way. . . .

MR. WILLIAM KENT: I regret that Mr. Halsey has not given us actual data in his paper. Mr. Halsey some three or four years ago proposed to me this premium plan, and I fortunately was then in a position to put it in practice at once, and it has been in use in the shops of the Springer Torsion Balance Company now for three years, with satisfaction to both parties. I heartily endorse the plan as admirable in every respect. I may admit, with one of the other speakers, that this plan may result finally in the piece-work plan pure and simple. Whenever experience has gone so far that you cannot improve the method of manufacture, and you have got into a rut, then the amount obtained under the premium plan will be a certain amount per week. You might just as well say that that is equal to so much a piece; but as soon as there is any chance of improvement, and men have not reached the utmost limit of their skill or discovery, so long as that is possible a premium plan is a good incentive to the workmen. In practice under the working of this premium plan, we have, say, a small piece of machine work, and we have no previous experience in making it, but we put a boy to work upon it, and find that by his ordinary skill, doing as he is told, he turns out, say one hundred pieces in a day. We tell him that there may be some quicker way of doing that work if he can find it out, and we tell him we will give him half a cent premium upon every piece he makes over one hundred a day. Now, we have had the number of pieces turned out jump up to three hundred a day, and that simply by some little knack that the boy discovered, which he was under no obligation to discover, and which he had no incentive to make before; he was not cheating his employer by not inventing or discovering that method before, but when we gave him an incentive to try and discover something, why, he went to work, and he succeeded, and added fifty per cent. to his wages. . . .

MR. FRANK H. BALL: I am very glad, indeed, to hear what Mr. Kent has said on this subject. I recall—and I presume other members here recall—a paper that was read at the Erie meeting by our ex-president, Mr. Towne; his plan was very similar to the method which Mr. Halsey proposes, and he called it gain-sharing. The difference between the two plans was simply this: In the plan of gain-sharing which Mr. Towne described the different departments of the business were divided, and the men in each of these departments were given a share in whatever they would save over certain fixed prices. For instance, in a foundry they found that it cost a certain amount per ton for labor, and his plan was to divide among the men what they would save over this fixed cost. In this case Mr. Halsey goes one step further, and brings it down to the men individually. . . . I think the idea is an excellent one. . . .

MR. H. H. SUPLEE: The gain-sharing plan has been in use at the works of the Yale and Towne Manufacturing Company, Stamford, and both parties are thoroughly satisfied with its operation. . . .

MR. HENRY L. GANTT: I think Mr. Kent's remarks are subject to another interpretation. If that hypothetical boy could increase the product with using the same tools by some little knack of his own three hundred per cent., why, it seems to me that either the foreman did not give him proper directions to start with, or else the foreman did not know; at all events, something was wrong to start with. The trouble there is still the same; you have not got to the basis. You want to know what a day's work is, to begin with. . . .

MR. ALMOND: I wish to call to the attention of the members something that was stated soon after Mr. Towne's paper, at one of the meetings in New York. A gentleman from Altoona stated a case which came under his immediate observation. There were two men who were requested to do their work by the piece, and during the three or four days that they were doing the work by the piece, one of them went to the foreman, and said: "I cannot make day pay this way"; while the other man said: "I am making twice as much as I was by the day." . . .

MR. E. F. C. DAVIS: I think most of the objections raised against piece-work are by people who have never had a good opportunity to observe how it works. It is very automatic and self-regulating in its workings. If one man is making too much on a job, and, by any particular appliance, is making very much more than his employer thinks he ought to make, there are ten chances to one that somebody else in the shop will notice the money he is making, and will come forward and make a bid to get that work at what he considers a fair profit for himself. So that the thing works all the time to the benefit of both parties. Whenever any new appliance is put to work, particularly by the foreman or the employer, no reasonable mechanic ever objects to having his prices changed in proportion. . . .

MR. JAMES MCBRIDE: The remarks this evening have proceeded entirely upon skilled labor. I want to make a few remarks about unskilled labor. The New York Dye Wood Extract and Chemical Company, of which I am superintendent, employs very largely unskilled labor. About two years ago the firm decided that they would set aside a portion of the earnings of the concern each year to be divided among their employes—not committing themselves in any way to their employes, but simply giving to them a certain amount of money in January each year, when the laboring man needs it more than at any other season, all in a lump sum. That plan was adopted two years ago. The result has not been altogether satisfactory, but it has been a very great improvement over the old system of simply paying them day wages. We find among the skilled mechanics that those who can reason to a conclusion are very much in favor of it. Among the unskilled laborers, while a good many of them do not exactly comprehend it, they think a good deal of it, so much so that when they get a man in among them that was born tired, they make it so hot for him that he is glad to get out. Our pay-roll has decreased in some departments very materially, from the fact that a good man refuses to work alongside of a poor man. . . .

Everything points to the conclusion that manufacturers in the future, in order to pacify their workmen and keep them quiet, have got to devise some means by which the workman can become a sharer in some way with his employer.

MR. HAWKINS: In 1877 I took charge of a machinery establishment in the city of Brooklyn. I attempted this plan: I did not know a single one of the workmen in the whole concern, but I called them all together, and I talked to them just as an employer or superintendent should talk to a number of men, expecting them to do the best they could. I gave them to understand that, if they did the best they could, due consideration would be given to reward those wl o did the best in the way of wages, and to dismiss or reduce the pay of those who did the worst. In the course of two or three weeks I found it necessary to discharge half a dozen men, from the fact that I could go about the shop and see that the work they were doing was being "nursed." I discharged them as examples, and I found my action resulted in great improvement on the part of the rest of the men. I then took the other course, and raised the wages of the men who were doing the best, and that made a still greater improvement. . . . I venture to say, that if I were to start a shop to-morrow, and adopt that course, I would undersell every one of you who pay these premiums or adopt these other methods.

MR. DANIEL ASHWORTH: I have listened very attentively to these remarks. . . . My friend, Mr. Hawkins, touched upon a very important point, and which he proposed, about carrying out a certain scheme to undersell his competitors. Now, mark you, there is one of the turning points. I know it from teachings of experience among many branches of industry in the United States. Systems have been developed upon this question, upon which this manufacturing concern would step forward in the market by some process of distribution of the pay, in the shape of premiums and piece-work, and the gentlemen on the other side would immediately figure it out how much cheaper they could sell these goods, and eventually they would invent some plan worse than before, because these competitors would be stirred up. There is the weak point. Cupidity dominates trade, and it is a constant attempt of one to overreach the other. There is the figuring in the office very elaborately, and it is presented as an ultimatum to the employes, that "we propose to carry out this system," and it is carried out. As has been repeatedly said, it is just like the old story of the naval distribution of prize money; you sift it on a ladder, and that which remains on the rungs is for the men, and that which falls through is for the officers. I can point you to industries in the Ohio Valley that for the last twenty years have had a species of competition beyond a parallel in the history of any industries in the world, and they have been going right along. They have been indulging in deception upon the great mass of their intelligent employes; they said there was no money in the business at all, that ruination was staring them in the face, and yet those establishments have been increased from one to four furnaces, and they have branched out in the different valleys where the natural fuel would reach them. With all our boasted civilization, we ignore the fact that these workmen are becoming more and more intelligent every day. When you will take the intelligent working masses and say to them, send your representatives to us when you see fit to appoint them, to discuss these questions, then you will have a starting point, and then you will have the data that has been so much talked about to night. And right there, I wish to say, as has been said by Mr. Weber, start right. . . . Intelligent men, such as our mechanics are, should be, and they are, able to agree with their employers upon an equitable basis.

MR. THOMAS R. ALMOND: . . . I take it, sir, that Mr. Ashworth is decidedly correct. I said to my foreman four years ago: "I want you to make those goods and fix the prices yourself, and as long as you work for me I will not make the prices any less." Since then I have increased those prices. I believe Mr. Ashworth is correct every time when he says that the manufacturers and the employers are more at fault than the workmen.

MR. WEIGHTMAN: These things always result in four or five different concerns reducing their prices until they get to the point of cutting each other's throats, and then they immediately form a trust binding each other that they will thereafter maintain a certain fixed price, by means of which they are safe against having their business eaten up. I know of such an instance recently, where some concerns agreed between themselves that they had been cutting the prices down too low on the strength of this very competition, and using their own employes as assistants in reducing the prices, until the concerns got so that they were not making the prices, but their employes were. They immediately had to form some plan by which they could control each other, and keep from going down too low. That trust was formed, and they are working along smoothly now. The employes still get their profits. There has been a slight advance, so that the companies themselves are satisfied, and the employes are satisfied. If you can get them to trust each other, and to believe they are semi christian, why, there will be some sort of an understanding in the labor problem.

PRESIDENT HUNT: Gentlemen, as interesting as this discussion is, I feel that the time we can afford to give to it in justice to our other papers has about expired. During a somewhat busy life I have been thrown in contact with the question constantly, and in the great development of the Bessemer business, particularly, we had constantly to meet new conditions, which have caused all of us—both the men and the employers—considerable trouble. The product this year would be a ridiculous amount to be satisfied with next year, and yet the same number of men would execute the work, because money is expended giving them facilities to do it, and with much less labor. Hence, these conditions had to be met in some way. Certainly the men ought to be willing to work for less pay per ton, but, if possible, more per day. I do not wish to detain you to give any of those instances, merely saying that in my judgment any step that is taken in good faith, looking towards the solution of this labor trouble, is worthy of respectful consideration. . . . Undoubtedly the foundation of the solution of all these difficulties will rest between the employer and the employe. If a manager is a fair man he will succeed in solving the difficulty much easier than if he is incompetent and unfair. Unfortunately there is another difficulty back of it all the time, and that is that some other man who does not work for you will

come in and be supported by your men in his right to assert his authority to discuss with you how much you are to pay. There is the most serious difficulty that I think any fair-minded employer has to meet.

MR. HALSEY: All I can say is that this system is not an invention of the enemy. Criticisms have been made to the effect that the result of competition would finally cut down prices to a basis where these premiums would not be justified. All of that proceeds upon the assumption that the premium is an extra amount given to the workmen without a corresponding recompense. The whole basis is to reduce the cost of work, and as I have put it in the last paragraph of the paper. Of course, if it does not reduce the cost of work it must fail. Upon the assumption that it does reduce the cost of work, it certainly has nothing to fear in the way of competition from outside sources. It seems to me that the best feature of the whole plan is the fact that it adjusts the law of supply and demand. You offer a man a premium for a given amount of work, and it immediately resolves itself into a question of supply and demand. Some speaker has said that the question at the bottom was to know what was a day's work, and then adopt a day's work price. How are you going to find out what a day's work is? I undertake to say that no one ever yet found out. No foreman can tell, until he has seen the man do it, what that man can be induced to do. . . .

DISCUSSION ON THE PAPER "JET PROPULSION," PRESENTED BY J. BURKITT WEBB.

(*This Paper appeared in our Issue of June 25.*)

MR. C. W. NASON: I would like to ask Prof. Webb, in regard to the duty of the engine or pump, whether there is anything more in it than merely the pressure?

MR. WEBB: The horse-power is equal to the reaction of the jet multiplied by the velocity of the jet. It is equal to the momentum of the jet. It is equal to the reaction multiplied by the space through which it acts.

MR. NASON: The pounds and pressure to the square inch, both multiplied by the velocity?

MR. WEBB: No, that will not give it.

MR. NASON: It is the quantity of water, then, in pounds, multiplied by the velocity?

MR. WEBB: The pounds pressure to push the vessel ahead is equal to the number of pounds of water per second, divided by the gravity, which gives the mass, multiplied by the velocity with which it issues. There is an interesting fact with reference to the reaction of the jet. Suppose at first the vessel is closed up, and you have a pressure of 100 pounds per square inch in the side of the vessel. If you open it, it relieves the vessel two hundred pounds. A hole in a vessel, where there is a pressure of one hundred pounds greater than outside, a one-inch-square hole open, will make a difference of two hundred pounds on that wall of the vessel inside; one hundred pounds because the wall is cut away, and another one hundred pounds because the pressure on the rest of the wall decreases.

MR. G. C. HENNING: I should like to say a few words in regard to this. It is so plain, that even the ordinary inventor can understand it. The other day I had occasion to look into this matter, because an inventor who wanted $40,000 for experimental purposes, to prove that he was right, came to me with a proposition to build a boat in which the water left the orifice just as fast as the boat went ahead. Then, of course, the action and reaction would be equal. Of course he believes with all of us that Dr. Jackson's theory, as illustrated in his beautiful little boat down at South Brooklyn, that the water issuing at a very high pressure acted like a steel rod against a solid wall, was all wrong. He said he had experimented upon his model in a keg of water. He had his model in there, and then he measured the speed of the water and the speed of the boat, and he found that the water moved just as far as the boat did. Hence he obtained the greatest efficiency, because he had the water to resist all around, and the action on the water and the action on the boat were equal, because the velocity of the water and the boat were equal, while, of course, he could drive his boat with any speed. It is a very pretty way of reasoning. But as soon as his attention was called to the fact that if there was any commotion in the tank beyond the starting line of the boat, why, then the water must have gone just a little bit beyond that line from the new position of the boat. Hence, the velocity of the water was equal to the number of feet from the new position of the boat to the point at which the commotion was stopped in the tank, while the velocity in the boat was read by the number of feet passed over from the starting point to the new position of the orifice.

MR. HENRY H. SUPLEE: It was my fortune to experiment to increase the efficiency of a screw propeller by surrounding it with a converging nozzle. The experiments were made on a little naphtha launch about twelve to fifteen feet long, and a propeller fifteen inches in diameter. The nozzle was made with a cross-jacket, so that the water would flow into it. It fitted entirely around the propeller, so that the water was drawn in by the propeller, and discharged through the tube. When the boat was moored fast to the wharf, and a swing balance inserted similar to the experiment described by Prof. Webb, it showed a marked increase in the pull on the swing balance when the tube was used. It seemed as if the propelling power of the propeller was decidedly increased. In some cases it ran up as high as twenty-five to thirty per cent. When the boat was loosed, and we endeavored to see the increase in the speed, there was a marked loss as great as ten or fifteen per cent., which was apparantly due to the increased resistance of the rods, etc., in the water. So that, while it gave a steady pull, it gave a very marked reduction in velocity.

MR. F. M. WHEELER: I have just come into the room, so that I have not had the benefit of all this discussion, but I would like to make a practical observation here. Some reference was made to a boat constructed in South Brooklyn on the principle of the jet, in which the inventor was more than sanguine in regard to the success of it. I always contended that, even if he secured the effect which he expected to with his jet, he could never practically apply it to vessels, for the simple reason that he has got to use a pumping engine. It is a well-known fact that the piston speed of a pumping engine is very limited. In direct-acting machines it is about one hundred feet. In the fly wheel machines it has been increased to 350 and even 400 feet. But what is that against the modern marine engine that makes from 800 to 1,000 feet. The practical application of that would be that the engine would be so very bulky and heavy, to say nothing about its lower rate of economy in steam, that you could not practically apply it for modern navigation; in other words, that the rule required for a pumping engine for this jet propulsion, providing the jet was a success, would be so great that you could not practically apply it with any success. Then, again, you would require more boiler capacity, for the reason that we do not get so great economy with pumping engines as we do with other types of engines.

MR. W. W. BIRD: I should like to ask one question. That is, if the jet was thrown into a vacuum what would the reaction be then?

MR. WEBB: I will say that the object of this paper was not to give all that could be said upon the subject, because one might write a book, taking up the way it appears to different people, and correcting all the errors. The object was to put something in a shape that can be understood—as Mr. Henning said, and I thank him for the compliment in saying that this thing can be understood—to prove that the reaction is the same theoretically and practically. The reason why a jet should do more in going into the air than in a boat is that, when it goes in the boat, it creates a current in the water, and makes more friction. I think if I understood Mr. Henning's remarks aright in reference to this inventor's plan, it was that he was to have the jet leave the vessel at the same speed as the vessel?

MR. HENNING: Yes, sir; the water moved back at the same speed.

MR. WEBB: That is a most excellent plan. That will give 100 per cent. efficiency and the machinery is the simplest in the world. All you have to do is to put a straight tube right through the vessel, and then the water will enter and leave at the same speed, and there will be no loss, except friction, and you can get a canal horse or something else to pull the vessel along. . . . That is the way in which all these schemes have been carried out. This high-speed jet was propelled by talking mostly. Now then, with reference to a remark by Mr. Suplee. If the propeller in an ordinary ship is surrounded by a tube—we won't say a conical tube, but let it be a parallel tube—it will prevent the power going to the radial velocity. Therefore, if we could put a tube around the propeller, and have no friction in that tube, we would gain something; but the friction in the tube probably would not be the element that would bring the speed of the vessel down. In reference to some other remarks as to the impossibility of running a vessel by a jet on account of using a pumping engine, why, every steam propeller is run by a jet. It is only a different kind of a pump. A propeller is a pump then, to give the velocity backwards; and the only difference between them and these schemes for running a small jet is that the propeller is large enough to propel the boat, and the jet is not, and the propeller runs at as slow a velocity as possible, and therefore gets a higher efficiency. Now, as to the discharge into a vacuum. It does not matter what it discharges into, no more than when you shoot a gun, it does not matter what you shoot at; if the gun kicks, it will kick. At the same time, if you plug the gun up it is not likely to let the ball go out. Consequently, reduce the pressure all the time outside to the vacuum, and the more you reduce it the greater the velocity of the escape will be. All the action done in giving the velocity to the water after the jet has got an inch or so from the vessel, makes no difference; you can put a board right up against the back of the vessel, provided you don't put it near enough to decrease the area of the whole of the jet. This principle occurred to me when the "Charleston" was sent after the "Itata." If the two vessels were able to steam at about the same speed, and the former had nearly caught the latter, and they then commenced firing at each other, the reaction of the guns would be a case of "jet propulsion;" that is, the re-action or kick of the "Itata's" guns, firing backward, would increase her speed, while the forward firing on the "Charleston" would retard her, and prevent her from overtaking the "Itata."

DISCUSSION OF TOPICAL QUESTIONS.

The first question discussed was: "What Limits are there to the Speed of a Hot Air or Caloric Engine?"

The discussion of this question brought out the opinion that such an engine could be run for pumping water as fast as any other; that its speed was limited by the pump. They had been run at 200 feet.

The second question was the old standby, venerable with the age of six or seven years, viz., How many times a Minute can the Dash-pot Apparatus, such as is used with the Corliss Valve Gear, be Lifted?

So far as we can see, the repetition of this question elicited no new information, although it was discussed at considerable length.

Topical Query No. 86, is: Which is Better Economy in a Foundry Cupola: to Melt Rapidly, producing a Relatively Cool Iron, or to Melt more Slowly, producing a Hotter Iron?

In discussing this question Mr. W. O Webber said:

I have a little data in this connection that I would like to offer. Along from May to the last of December, 1890, we were getting about an average of 100 tons of clean castings a week from a 60-inch cupola, and melting about eight tons per hour at that rate. The ratio of iron melted per pound of fuel was seven and a half. The number of pounds of clean castings that we got out of the total amount of iron put into the cupola was seventy-five and three-fourths per cent. We wanted to increase the amount which we could melt in that cupola. Our foundry foreman said of course it could be done, but at a sacrifice in the per cent. of good castings that we would obtain; that is, in melting it faster we would not melt it so hot, and we would lose more casting. I did not agree with him, and from January 10th to May 29th of this year we crowded the cupola so that the average melting for that period was at the rate of eleven and a half tons per hour. The ratio of melting pounds of iron melted to pound of fuel, is nine and a half. The difference between the efficiency of the cupola over the previous one is on the right side of the account. We got seventy-five per cent. of good castings; so that the difference is very slight when you come to reduce it down to figures, and take a record for a certain period, which is the only fair way. It makes a difference also of about three dollars a ton on the economical side of it on the quicker melting. We have had some remarkably good weeks. During the week ending May 7th we melted thirteen and a quarter tons per hour in a common 60-inch cupola. We melted ten and three-tenths pounds of iron per pound of fuel, and the efficiency that week was 76.4 per cent.

MR. E. C. F. DAVIS: I would like to ask Mr. Webber how he obtained this increase?

MR. WEBBER: It was simply by using a stronger blast, and putting in another row of tuyeres.

MR. H. L. GANTT: I would like to ask what the blast pressure was?

MR. WEBBER: Fourteen ounces, using just common coke.

Mr. L. C. Jewett presented a contribution to the discussion, in which he reasoned in favor of slower melting, and the production of hot iron as producing better castings, a smaller percentage of loss, and saved bunging up ladles, cupola, etc., all of which resulted in loss.

Mechanical Curiosity.

What is there in a pile-driver, or its operation, that stimulates human curiosity to such a noticeable degree? The putting up and setting in operation of a pile-driver anywhere is sure to immediately draw a crowd, and keep a considerable portion of the people who compose it standing idly by to watch the monotonous repetition of the movement of the pile-driver's simple machinery and heavy weight, which is drawn up and then let go, to come down with a thud on the top of the unoffending and helpless stick of timber, driving it every time a few inches deeper into the mud. Wherever this operation is going on, you will see a crowd of from a dozen to one hundred and fifty men and boys, who appear to take as much interest in it as they would in a Punch and Judy show or a dog fight. We do not understand where the curiosity-exciting element is. After one has seen the big thumper go up and come down once, he has seen all he ever will see of the mystery of pile-driving. Yet crowds of idlers are found hanging around the pile-driver's station for hours. Are these people really curious, or are they only lazy and loafing?—*The Evening Journal* (Jersey City).

During the early part of June the White Star Royal Mail steamer Teutonic made the passage from New York to Queenstown in 6 days 6 hours. The sister ship Majestic, which took the long route, made the passage to New York in 5 days 22 hours, being the fastest western passage this year.

The Pennsylvania Railroad Company is to give its freight clerks in Jersey City a week's vacation each this summer and a pass to some summer resort on its lines.

Improved Jib Crane.

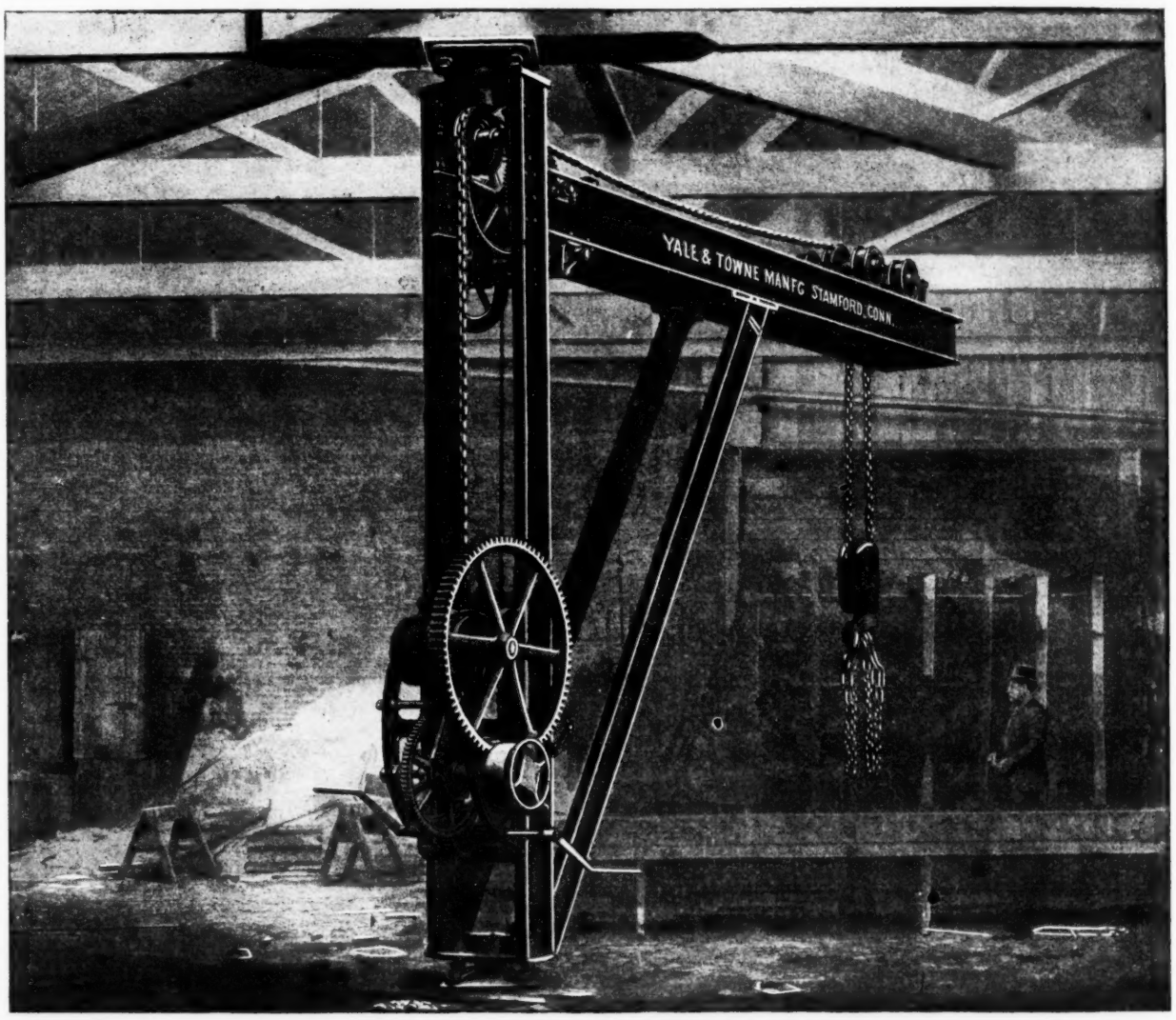
The jib crane shown in the illustration is one designed by the Yale & Towne Manufacturing Company, Stamford, Conn., and is a most convenient and useful form for foundry use. It embodies in its construction a number of points which add greatly to its safety and efficiency, and which will repay a critical examination. The framework of the crane is composed of a double system of rolled channel bars separated sufficiently to give proper room for the attachment of the mechanism, and to permit the main chains depending from the trolley to pass between the two irons forming the jib, and the construction and manner of connection are clearly shown in the illustration.

The operating mechanism may be considered in two parts, viz., the winch, by which the operations of hoisting and lowering are effected, and the trolley mechanism, by which the trolley is traversed upon the jib.

The hoisting chain, after having passed about the blocks, is wound on a grooved drum of large diameter, motion being given to the drum by a train of spur gearing operated by the hand cranks, enabling the speed to be adapted to the load to be raised. The large diameter of the drum reduces the bending and wear of the chain to a minimum, and the direct train of spur gearing enables a high degree of efficiency to be secured.

Lowering is effected by turning the cranks backward, the load being at all times sustained by the action of the Weston safety pinion, and the rapidity of the descent is entirely under control at all times. When the motion of the handles is stopped the lowering ceases, and should the handles be suddenly let go their motion will stop at once, as it is impossible for them to fly back. The value of this safety feature cannot be too highly estimated, as it removes all danger arising from loss of control of cranks or brakes.

When the empty chain or light loads are to be lowered rapidly, the "dispatch lowering device" may be used. This is operated by the hand-wheel shown just beneath the large spur gear wheel in the illustration, and by its use the load may be permitted to run down at any desired speed, remaining at all times under the entire control of the operator. Under these circumstances the hand-cranks and gear train remain at rest; the drum gear and pinion only being in motion, and rapid lowering is thus safely and readily accomplished.



IMPROVED JIB CRANE.

While the crane shown in the illustration is typical of the entire line of jib cranes made by this company, the details may be varied to meet special conditions. The point of attachment of the braces which support the jib may be varied within certain limits, and the necessary changes are made in the proportions of the various parts to provide for the different capacities which are regularly built.

Cranes of this type are built in sizes from one to six tons capacity, and are well adapted to meet the general requirements of foundry and machine shop use. Jib cranes of heavier design are made of capacities up to 25 or 30 tons, the jib in such cases being formed of a "built-up" girder, and the modifications being only such as are required to meet the increased capacity. Pains are taken to secure good workmanship and material, and to arrange the cranes with special reference to convenience, speed, and durability.

The Suez Canal too Small.

The most important deduction to be obtained from the annual report of M. Ferdinand de Lesseps to the shareholders in the Suez Canal is that the facilities of the waterway are rapidly falling behind the enormous increase of traffic, and that before long probably even the relief afforded by the recent diminution in the time required for transit will be found insufficient. The report shows that during the year no less than 3,389 vessels passed through the canal, giving a total receipt of £2,697,000. The principal work carried on in the period covered by the report has been the widening of the maritime canal by 15 miles. This work has been carried from the tenth mile from Port Said to the fifteenth, and it is intended during the present year to carry it as far as the twenty-second mile. The other widening works also in course of execution have been continued vigorously, and the new basin at Port Said has been excavated to its full width for a length of 300 miles. The crowding of the canal is so severely felt that the engineers have determined to abolish the supply of stores, etc., by water, to the stations of the company between Port Said and Ismaila. The boats and barges at present employed will therefore be displaced in favor of a steam tramway, which is now in active construction. The Egyptian government has entered into negotiations with the company for the employment of this tramway as a public line for the transport of passengers and merchandise. One other noteworthy feature of the report is the statement that the development in the petroleum commerce of Port Said has rendered it necessary to undertake the construction of an isolated dock at that place for the accommodation of this traffic. At the annual meeting of the company in Paris the whole of the resolutions presented by the committee of management were approved, and MM. Chabrières-Arlès, Boucard, Guichard, and Lord Brassey were elected directors.—*The Engineer* (London.)

A New Hampshire senator is furious over the idea that politicians of some other complexion than his own are "controlling the navy yard employes" at Portsmouth, by which it is meant that they are having their say as to who shall be employed. Let mechanics think for a few minutes that their right to government employment depends upon whether or not they belong to some political party, and then get a job anywhere else than in government works. The idea that a first-class mechanic must have a pull—for all the world like a politician—before he can work in government shops, is degrading, and it explains why so few good mechanics are in government employ.

Strength of Malleable Iron Castings.

Very little is generally known with regard to the strength of malleable iron castings, and the results of some experiments made by a committee of the Master Car Builders' Association have therefore special interest. Samples of these castings were obtained from the National Malleable Casting Co., of Chicago, and were tested in laboratory of the C., B. & Q. R. R. at Aurora. The following table gives the results of tests:

TENSILE TESTS OF MALLEABLE CASTINGS.

Nominal dimensions. Inches.	Actual dimensions. Inches.	Area in square inches.	Tensile strength per square inch.	Per cent. of elongation in 4 inches.	Elastic limit per square inch.
1½ x ¼	1.52 x 0.25	0.38	34,700	"	21,100
1½ x ⅜	1.52 x 0.39	0 593	33,700	"	15,300
1½ x ½	1.53 x 0.5	0.765	32,800	"	17,000
1½ x ⅝	1.53 x 0.64	0.979	32,100	"	19,400
2 x ¾	2 x 0.78	1.56	25,100	1½	15,400
1½ x ⅞	1.53 x 0.88	1.355	33,600	1½	19,200
1 x 1	1.06 x 1.02	1 08	30,600	1	17,600
1¼ x 1¼	1.28 x 1.3	1 664	27,400	1	.....
1½ x 1½	1.52 x 1.54	2 341	28,200	1½	.....

It will be noticed that while there is no great regularity in the variation in strength of the different specimens, the thinner ones are strongest proportionately, and both this irregularity and the decrease in strength with increased thickness are just what would be expected by any one who had had experience with such castings.

The Providence *Journal* had the best daily report of the proceedings of the mechanical engineers in that city that we have ever seen published by a daily paper. It was prepared by Mr. John W. Barney, who attends to mechanical matters for the *Journal*. By way of comparison, the *Journal* says: "The Mechanical Engineers Convention differs from that of the Electric Light Association in an entire absence of the 'business' element. The February meeting was almost as important as a commercial exchange as for the presentation of instructive papers. The electrical press made elaborate display in the hotel parlors, one of the journals even publishing a daily bulletin of the proceedings. Buyer and seller were brought together, and business throve. The technical journals represented this week have their men here for the hard work of report and editorial comment upon the ideas brought out by the papers and the discussions. There is a notable absence of the trading spirit, and the interest is the more thoroughly centered in the proceedings of the official programme."

The arrangements for showing the visiting engineers through works were good. The plan employed at the works of the Nicholson File Company was different from usual practice. Those who have had experience in such matters know how difficult it is to get two hundred or three hundred persons to follow a leader through large works; they straggle, break the line, and are continually coming to turns without knowing which way to turn. At these works a man was stationed at every turn to direct straggling parties in the line of the main procession. The plan worked excellently.

So far it has been impossible to get at the number in attendance at the meeting. This is owing to the fact that a great many fail to register in the society's book provided for that purpose. It is probable that there were present—including ladies and guests—between four hundred and five hundred, making it the largest meeting ever held by the society.

The committee for nominating officers for next year is as follows: Thomas J. Borden, T. Spencer Miller, Robert Allison, John Thomson and Frederick M. Wheeler.

Altogether, 456 vessels were repaired by the Bute (England) Shipbuilding and Engineering Company during the past year. Of these, 289 entered their dry dock, the rest being repaired outside. Notwithstanding some heavy losses, the company declared a dividend of 7½ per cent.

The new twin screw steamship of the French line—La Touraine—is 450 feet long, 57 feet breadth, and 37 feet depth. She has a guaranteed speed of 19½ knots. In a 20-hour run she is said to have averaged over 21 knots. There are accommodations for about 1,100 passengers.

It is stated that the heaviest single article exhibited at the Royal Naval Exhibition consists of a hollow forging, technically known as a gun hoop, from the works of Sir Joseph Whitworth & Co., Manchester. It is 23 feet long and weighs 34 tons.

Worm Wheel Teeth.

BY FREDERIC R. HONEY, PH. B., Instructor in Trinity College.

Draftsmen and pattern makers frequently experience difficulty in determining the correct form of the worm wheel tooth. The text books on mechanism usually indicate the principles involved in making the drawing, without giving specific directions in regard to the details of the work. The problem is not difficult, but time and patience are required for the attainment of an accurate result. In order to make the constructions clear, we explain the steps which the draftsman should take in their order, and, to avoid confusion of lines, a large number of illustrations are given.

We begin by indicating a simple method of deriving the form of the tooth of a wheel from those of the rack with which it is to gear. Let Fig. 1 represent the teeth of a rack whose pitch line is tangent to the pitch circle of the wheel at the point *o*. In order to ascertain the form of the tooth of the wheel which is to work in the space *a b c d*, proceed as follows:

Let Fig. 2 represent a template *a b c d* corresponding to the space between the teeth of the rack, and *e f*, the pitch line. Draw on the template the parallel lines 1, 2, 3, etc., etc., at equal distances apart, and perpendicular to *e f*.

Lay off on the pitch circle of the wheel (Fig. 3) distances equal to those between the lines 1, 2, 3, etc., of the template, and to these points draw the radial lines 1, 2, 3, etc. Revolve the template into positions so that its straight edge *e f* (which represents the pitch line of the rack) is tangent to the pitch circle of the wheel. This is readily done by making the lines 1, 2, 3, etc., of the template respectively continuations of the corresponding radial lines 1, 2, 3, etc. Thus, the extremity of the line 4 of the template is brought into coincidence with the extremity of the radial line 4, and these lines are made continuous. In order to avoid confusion, only two positions of the template are shown in the drawing. Trace upon the paper the outline *a b c d* in its different positions. The form of the tooth *g h i j* is determined by drawing tangents to these curves. In the drawing the tooth is a little smaller, allowance being made for inequalities in casting. The draftsman may decide to make a greater allowance for backlash.

Let Fig. 4 be the plan of a quarter of the worm; Fig. 5 the elevation of that part which is needed for the constructions. Unnecessary lines are omitted. The plan of the axis is *o*; its elevation *o'*. The fine outline on the left of the axis *o'* gives the form of the section of the thread by a plane which passes through the axis parallel to the plane of the paper.

To construct sections of the thread by the parallel planes a b, c d, e f and g h (Fig. 4).

The elevation of the section whose plan is *a b* is evidently the given outline *a' b' b'' a''* (No. 1).

Draw the plans and elevations of five helices on one surface of the thread; that is, three in addition to those which limit it—one passing through the pitch point.

The elevation *c' i'' j'' k' d'* (No. 2) of the section whose plan is *c d* (Fig. 4) is found by drawing the curve through the points *c' i'' j'' k'* and *d'*—the elevations of the points whose plans are respectively *c*, *i*, *j*, *k* and *d*. Similarly the elevations *e'*, *l'*, *m'*, *n'*, *f'* (No. 3) and *g'*, *p'*, *q'*, *r'*, *h'* (No. 4) of the sections whose plans are respectively *e f* and *g h* are found.

In order to draw the other curve for each section, lay off the five perpendicular measurements (limited by arrow heads) equal to the corresponding distances in the section *a' b' b'' a''* (No. 1). They measure the space between consecutive turns of the thread at five points. Let Fig. 6 represent the generatrices of the surfaces of revolution which limit the tooth of the wheel. The arcs drawn with broken lines are described with the same radii as the corresponding arcs in Fig. 4. In those drawn with full lines—representing the point and root of the tooth—allowance is made for clearance.

The sections of the tooth of the wheel, Nos. 1, 2, 3 and 4, are derived from the corresponding sections of the thread of the worm in the same manner as described for the outline of the tooth *g h i j* (Fig. 3). In each case a template should be made corresponding to the section giving the outline of the space between the consecutive turns of the thread, the straight edge of the template *always coinciding with the pitch line of the worm*, indicated by the heavy line in the drawing; and this pitch line should be revolved into positions tangent to the pitch circle of the wheel as illustrated in Fig. 3.

In order that the template may be properly adjusted to its first position, the point *o*, where the pitch line of the worm intersects the center line *o' o*, should be brought into coincidence with *o'*. This remark applies to each of the cases Nos. 1, 2, 3 and 4.

The section of the tooth No. 4, which is beyond the assigned limits, is constructed in order to enable the draftsman to ascertain the direction of the lines of intersection of surfaces of revolution generated by the arcs (Fig. 6) with the bearing surfaces of the tooth, and also the thickness of the tooth at the root.

If the center lines *o' o* (Nos. 1, 2, 3 and 4) be made to coincide we have (Fig. 7) an end view or elevation of the sections of half the tooth in their correct relative position.

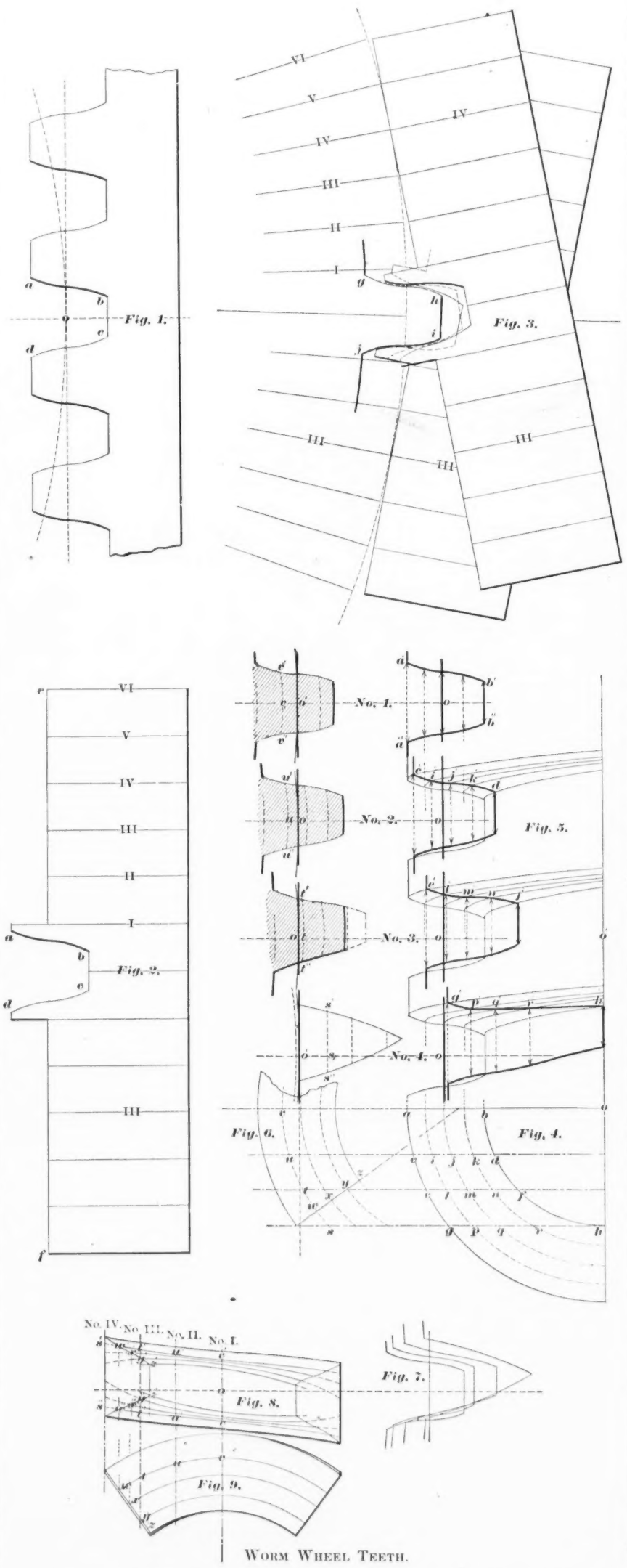
In order to construct the front elevation of the tooth (Fig. 8) draw the perpendicular lines Nos. 1, 2, 3 and 4 at distances apart equal to the distances between the lines *a b*, *c d*, *e f* and *g h* (Fig. 4). Referring to Fig. 6 the elevation of *s* is s_1 (No. 4); the elevation of *t* is t_1 (No. 3); the elevation of *u* is u_1 (No. 2); and the elevation of *v* is v_1 (No. 1). Through the points s_1 t_1 u_1 and v_1 draw arcs concentric with the pitch circle which passes through *o'*, intersecting the outline of the section of the tooth in each case as follows: No. 4 at *s'* and *s''*; No. 3 at *t'* and *t''*; No. 2 at *u'* and *u''*; No. 1 at *v'* and *v''*. The distance from each of the points *s' s'' t' t'' u' u'' v' v''* to the center line *o' o* is laid off from the horizontal center line through *o* (Fig. 8), and through the points thus found the curves *s' t' u' v'* and *s'' t'' u'' v''* are drawn. In the same manner the other curves are constructed. Four of these, shown in heavy lines, limit the tooth.

Points on the outlines *w' x' y' z'* and *w'' x'' y'' z''* are found on these curves at distances from the perpendicular line No. 1, equal respectively to the distances from *w x* *y* and *z* to the center line *v a* (Fig. 6.)

The two halves of Fig. 8 are *symmetrical with respect to the center o—i. e.*, the half of the tooth on the right of the center will be found by revolving the half on the left through an angle of 180° about the center *o*. This will be constructed by making the ordinates of the curves *above* the center line on the right equal to the corresponding ordinates *below* the center line on the left; and those *below* the center line on the right equal to the corresponding ordinates *above* the center line on the left.

The pattern maker should construct templates corresponding to the sections of the tooth Nos. 1, 2 and 3. The templates for Nos. 2 and 3 should be *inverted* when employed in determining the form of the half of the tooth on the right.

Fig. 9 is the plan of the tooth.



WORM WHEEL TEETH.

Fifty Years' Losses of British Warships.

In fifty years 70 British warships were lost otherwise than in action, and these measured 60,448 tons, or little more than the measurement of the vessels captured in Nelson's great victory at Trafalgar. When it is remembered that the vessels are all well found, and that they are not always on the move, as in the case of merchantmen, the total may seem large; but it is only at the rate of about one vessel of 1,209 tons a year, and when it is noted that there are on the navy list 70 armored and over 200 unarmored vessels, the percentage of loss is very small indeed. The largest vessel included is the "Sultan," stranded at Malta; but as she was subsequently raised and may again go into the service, we have not included her tonnage in our total, which, with the vessels included, would have been 69,738 tons. "The Captain" is the next largest vessel on the list. It will be remembered that she was capsized off Finisterre by pressure of sail assisted by the heave of the sea, the court finding that the sail carried at the time was not sufficient to have endangered a ship endued with a proper amount of stability. This foundering was the most disastrous in point of loss of life in the annals of British warship recent disasters. "The Vanguard," the next in size, was run into by the "Iron Duke" in 1875, off the coast of Ireland, while cruising. The cruiser "Serpent," by the loss of which 173 officers and men were drowned, is the most recent wreck. It is a noteworthy coincidence that in 1884 the gunboat "Wasp" was wrecked, and that the next vessel to be lost was also named "Wasp." In both cases there was heavy loss of life. Six vessels in 1854 were left in the ice in the Arctic regions, and in none of the cases was fault found with the

officers for leaving their ship. On the other hand, the story of their voyage and their hardships and trials, ere they gave up their forlorn hope, are illustrative of British pluck, and, although it does not come within the scope of the parliamentary return, it may be assumed that there was revealed in the case of many of the casualties that heroic valor characteristic of the British sailor.—*Engineering* (London).

LETTERS FROM PRACTICAL MEN.

Strain on Bolts.

Editor American Machinist:

Chip's man Thompson is made to say in the issue of June 4th, that "For steam, water and other pressures where it is necessary to screw the nuts up tight to prevent the escape of the steam, etc., the bolts are subjected to a double load—that due to screwing up the nut, and the pressure of the steam when the load comes upon the bolts." As many experienced persons to whom we look for the correct determination of mechanical principles tell us that there is no more load or strain upon such bolts unless the pressure of steam exceeds the stress put upon them by screwing up the nuts, we get somewhat mixed, because, if these persons are right, there can be no such "double load" upon the bolts at any time, and Mr. Thompson must be wrong. Which is right?

C. S.

[This question was quite fully discussed in the AMERICAN MACHINIST for 1887, the balance of opinion being that, but for the question of elasticity of the metals, or packing, the strain on the bolts would not be increased by pressure in the cylinder until that pressure exceeded the initial tension of the bolts.

Change Gears by the Slide Rule.

Editor American Machinist:

I have watched with interest the animated discussion on finding change wheels for odd pitches, and having lately thrashed out the problem in my own way, I send you my rule, which materially differs from any of those mentioned up to date.

I may preface these remarks by observing that I make considerable use of the ordinary logarithmic slide rule—an instrument 10 inches long, costs but a few shillings, and its value for checking calculations, working proportions of pulleys, computing tables of inverse proportions, etc., to say nothing of weights of bars, areas, etc., is something to be made a note of.

It is especially applicable to proportion sums involving an approximation, as in the case of odd pitches, and is used in the following way:

Call the fixed divided line *A*, and the slider *B*. Set the number of threads in leading screw (say 4) to the odd pitch (say 37 per inch), 4, on *A*, being placed opposite line 37 on *B*, then every number (represented by a line) on *A* will be $\frac{4}{37}$ of the number exactly opposite to it on *B*. If two lines are nearly opposite, the proportion will be nearly correct, and the nearer the lines coincide the more accurate will be the proportion.

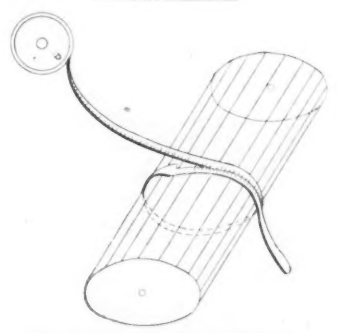
If we had change wheels rising by one tooth, we could, of course, use $\frac{4}{37}$ at once, but bearing in mind that the wheel teeth rise by fives, we must look on the slides only at the lines representing multiples of fives, which are usually longer, and shaded darker.

Now, looking along the two rows of lines, we find $\frac{10}{110}$ to be somewhere not far off, but further along we get $\frac{60}{550}$, very close, but $\frac{65}{600}$ is very close indeed, giving slightly too coarse a pitch, while $\frac{70}{650}$ is about as near, giving slightly too fine a pitch. Taking the latter as a shade more accurate $\frac{70}{650} = \frac{35 \times 20}{65 \times 100}$ which will cut a pitch of 37.14 threads per inch.

Again, take at random $\frac{17}{23}$ threads per inch with 4 thread leading screw $\frac{17 \times 4}{23} = \frac{68}{23}$ = almost exactly $\frac{220}{650} = \frac{110 \times 20}{65 \times 100}$ which wheels will cut .7387″ pitch against $\frac{17}{44}$ = .7393″ pitch required. This letter has taken just half an hour to write, including the two calculations, and proving them, so you can judge of the efficiency of the rule thereby.

PERCY J. NEATE.

Rochester, Eng.



Handy Outside Calipers.

Editor American Machinist:

Thinking that the enclosed might be useful to some of your readers, I forward it. Finding that I sometimes needed a pair of calipers that would measure the diameter of work as large as three or four feet, and from past experience with such tools did not care to use these, on account of the inherent spring, unhandy size and weight, and the impractibility of putting them in an ordinary tool chest, I got a twelve-foot steel tape (Chesterman's) *not graduated*, and graduated it myself with acid, so as to show inches and hundredths on one side, and inches and sixty-fourths on the other side *of diameter*, when passed closely around a true circle. Thus one inch graduated on the tape was equal to 3.14159 + once the thickness of the tape in inches, and by a short piece at the end, set over to one side, equal to the width of the tape, and graduated for a short distance, to act as a vernier. With the graduations on the whole length of the tape I could measure large circular work very easily and conveniently, and with a tool that I could carry in my vest pocket.

Of course I know that we very rarely find a piece of work that can be called truly circular, but ordinarily lathe work is so near circular that a man can generally make a better fit with the tape than with calipers. I have often wondered why some enterprising manufacturer does not make such a tool; I am sure it would find a ready sale.

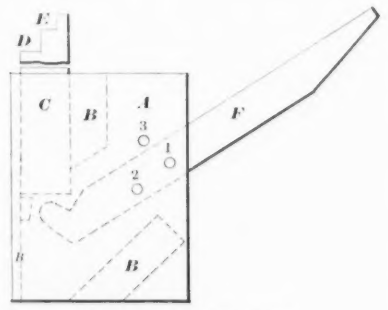
FRED. W. SALMAN.

A Cheap Wheel Jack.

Editor American Machinist:

About a year since, after looking about for a buggy wheel jack, and not finding what I wanted, I made one as represented by the accompanying sketch, and one year's wear and tear of the roughest kind has proven it so good and serviceable that I hereby give it to the fraternity.

I made the whole of ordinarily clear pine stuff, of thickness as given. The sides *A* are $\frac{5}{8}$″x11″x14″. The partitions *B* are $1\frac{1}{4}$″ thick, and placed as represented. The post *C* is $\frac{1}{16}$″ thinner than the partitions, so that it may slide freely up and down; it is 3″ wide by 18″ long. The distance from *D* to



CHEAP WHEEL JACK.

E is the difference in height of wheel centers forward and back. The lever *F* is $\frac{5}{8}$″x 3″x24″. The holes are $\frac{7}{8}$″ diameter; No. 1 is the fulcrum of lever, No. 2 is for the reception of the pin under lever to hold the load while in operation, No 3 is for the safe keeping of the pin when not in use. The operation of the jack must be apparent to all.

M. L. BULLOCK.

Passaic, N. J.

A Drilling Jig.

Editor American Machinist:

A friend of mine was showing me a plan for a drilling jig that I think would prove to be a convenient tool in most any machine shop. He has not tried this yet, but says he intends to as soon as he gets a chance; in the meantime perhaps some of the readers of the AMERICAN MACHINIST might like to try it.

Of course he does not recommend this for all cases, but only those where it will well apply, and I think there are plenty. Fig. 1 shows the jig, bushing and center. His idea is to make the bushing *A* of steel, hardened, and to drive it in its place to stay. The center shown should fit this bushing, and also there should be a full set of drill bushings (one shown) to fit, and with holes to correspond with the standard drills in use. The idea of having the set-screws as shown is to be able to get the bushing *A* to a good bearing on the surface of work, and the sharp edge on this bushing will make it stay in place when clamped.

I have shown holes for the set-screws at *c*, *c*, *c*, *c*, for use when it is not convenient to get a bearing so far out on the strap.

In using this rig he would first lay out the holes to be drilled, as is usual, except, perhaps, it would not be necessary to draw the usual circle. Then, with the center in its place in spindle, he would run it through bushing *A* and into the center punch-mark in work. He would then adjust screws *D D* till they got a good bearing, and then clamp fast. He can then use any drill bushing he chooses, and proceed the same as with any jig.

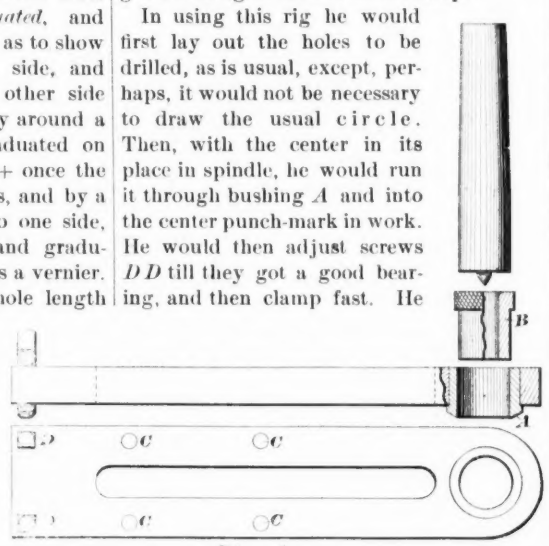


Fig. 1.

A DRILLING JIG.

I think it would be well if such a tool, with a full set of good, hardened bushings, were made and kept the same as other shop tools for use when needed.

A MECHANIC.

The Premium Plan.

Editor American Machinist:

The article on the "Premium Plan of Paying for Labor," in the last issue of the AMERICAN MACHINIST has interested me not a little, and I would have been very much pleased if we could have had it accompanied by some details of the discussion which followed the reading of Mr. Halsey's paper at the Providence meeting—as it might have helped us to more clearly comprehend its full import.

To me at least the premium plan does not present the pleasing aspect it does to Mr. Halsey; he seems to start off with the idea that the capitalist or employer is being cheated out of his dues by disinterested workmen; accompanied by the fear lest said workmen reap the full benefit of their labor. Now how to get more work out of the men without paying too much for it is the employers' problem.

For ages back various means have been tried to accomplish this end, and last of all comes the "premium plan." It reminds me of a man holding out a piece of meat to a half famished dog that is chained. He holds the meat so that the dog barely reaches it, but by straining its chain almost to breaking and nearly strangling itself, it is able to snatch a mouthful; so the employer, cleverly assailing the workman on his weak point (his necessity), tempts him on. There seems to be an ever-increasing desire to make the workman more and more a part of the machine he is manipulating, until even his understanding is mechanical, so when he seems to be dilatory they take up his belt, put him up a speed and make his feed more positive, knowing well that the less time he gets to think of his condition the better he will accept it.

Mr. Halsey contrasts his plan with the piece-work plan. In my opinion the difference is but slight, and I do not favor either of them, as I consider that any such plan has a demoralizing effect on the men, who, in order to gain anything, have to become rushers. The rusher deals in quantities irrespective of quality, and so the workmanship goes down the scale. Such are some of my views of the premium plan. That we may hear more about it and that some of our thinkers will give us some of their thoughts about it, is the wish of

N. Y. City. MIKE CAWDINE.

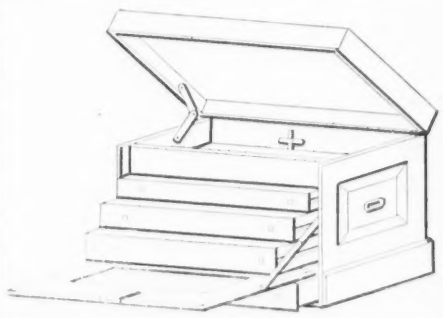
[Our correspondent will find the discussion of this paper in this issue.]

Another Tool Chest.

Editor American Machinist:

I see Mr. Penney's request asking how to build a tool chest, and I send you a drawing of the way I built mine. In the top is a till, in which I keep heavy tools. Next comes three drawers, in which I keep smaller tools. The three drawers are enclosed by a drop door, which, when open, is held in a horizontal position by folding metal straps at each end, making a handy table. The door, when closed, sets in the front of the chest, and is held in its place by the lid, which shuts over the top edge of the door about $\frac{3}{16}$ of an inch. The lock is fastened to the door, and when closed locks into the lid. Then there is a drawer in the bottom, where I keep tools that are not in constant use. The drawer is fastened by a bolt in the back of the chest, which is made so as to draw the drawer in, thus making the miters at each end tight.

G. E. OATHOUT.



ANOTHER TOOL CHEST.

Immersed in Molten Metal.

But few men have ever fallen into a pot of molten metal and escaped with a few trifling burns; yet John Adams, of Tacoma, did it the other night. He is an employe of the Ryan smelter, working on the night shift, and it is only through great presence of mind that he was not burned to death. By some misstep he lost his balance and started to fall headlong into an immense pot of molten metal. As he fell he caught the rim of the pot, and although he was immersed almost to his armpits, he drew himself out, and with almost superhuman effort threw himself into an adjoining pot filled with cold water. Some of his fellow-workmen saw him cast himself into the pot, and rushing to his assistance, rescued him. His hands were badly burned, but otherwise he had hardly a scar on him. The secret of his escape was that he had on heavy woolen underwear and outer clothing, and before it had been burned through, Adams was in the pot of cold water.—*Tacoma Globe.*

It is reported that the Chinese government is erecting extensive steel works at Learghoo, under the superintendence of Mr. H Hobson, C. E., and a party of English mechanics from Workington, on the Solway coast. The whole plant required in the construction of the steel works and blast furnace came from the north of England. The workmen employed are exclusively Chinese, about 3,000 in number.

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Not Responsible.

The trial of the directors of the New York, New Haven & Hartford R. R. for running passenger trains within this State heated by stoves, whereby a number of people were roasted to death in what is known as the tunnel disaster, has resulted in an acquittal, upon the ground practically that men cannot commit crime, vicariously. Among other things, the judge is reported to have said that "at the time of the disaster the law was not being violated, because no passengers were on the train at the time the accident happened."

This to the ordinary lay mind seems like an exceedingly small loophole, when it is remembered that the train had just come in loaded with passengers, and was merely being drawn away from the station to be prepared for another trip, employes—car cleaners, etc.—being the victims. Again, in the case of President Clark it was said that there "was no direct evidence that he ever gave orders in regard to the dispatch of the train on which the law was violated." This, we suppose, means that, in order to be held responsible, he must have himself given the order for the train to be started, knowing at the time that it was heated by car stoves, which, it will be seen, reduces the chance of responsibility being fixed upon railroad presidents to a very small one.

Of course nobody expected the president and directors of this road to serve a term in jail as a result of the slaughter which resulted from their plain violation of law, but it was hoped that it would be shown that it would be unsafe for railroad directors to deliberately violate a law passed for the protection of the public. But as the matter now stands the public seems to have decidedly the worst of the matter.

We do not doubt that the acquittal is in accordance with law, but that does not in the least lessen its absurdity. In plain terms, the president and directors control the management of a railroad. That is what they are for. They should know whether laws are being observed or violated by the road, and, if violated, should in some way be held responsible.

Otherwise we fail to see what use there is in legislation regarding railroads. If the present laws are insufficient to secure and fix responsibility, laws should be passed that will be effective.

The Prospect of Flying.

There are indications of an increased interest in the subject of flying machines, and many men who are not visionaries seem to believe that a practical flying machine is possible.

Prof. S. P. Langley read a paper a short time ago at the annual meeting of the National Academy of Sciences, in which he gave the results of some experiments made by him, which seemed to show that, so far as the power is concerned, the thing is possible with steam engines now made, though he did not venture to say that other practical difficulties would certainly be overcome.

Mr. Hiram S. Maxim, the inventor of the well-known Maxim gun, has been making some experiments with a machine, of which he himself says: "The novel features consist principally in the system of generating an enormous force with a very light engine operated by petroleum."

He says there seems to be some reason to hope that the machine will actually fly, and gives the figures upon which his hopes are based.

It is, of course, needless to say that the modest expression of a hope by such a man as Mr. Maxim will be far more encouragement for those who desire to see aerial navigation than would be the most positive claims of success coming from such a quarter as the Mount Carmel institution, with its boasted $20,000,000 cash paid-up capital.

When a thing gets to the point of enlisting the efforts of men who are known to be practical, and who, instead of attempting to throw an air of mystery about their experiments, announce that they are working along the lines of well-settled principles, and have hopes of success, then others may have hopes.

Aerial navigation may never be practically realized, but there are indications that within the next few years we shall know whether or not it is possible, with our present advancement in the art of motor building.

Not All Interchangeable.

It would be better for all concerned in many instances if it could be more generally recognized that men are not all made upon the interchangeable plan, so speak. This is more particularly the case where new establishments are to be organized by men who have, perhaps for years, been connected with a concern engaged in a business similar to that proposed. The methods of no two concerns are, or ever can be, precisely alike. A man who has been for years in a certain position, and is entirely successful in it, has either adapted himself to the position, or the position happens to be adapted to him. He has acquired certain methods of working which may have been originally and naturally his own methods, to which others associated with him have adapted themselves, or may have been acquired, as a result of peculiarities of surroundings. These methods may, in many instances, become crystallized into habits, in which case it is usually very difficult for the men possessing them to make the change that may be needed to enable them to succeed in new surroundings, and with others as associates perhaps equally prejudiced in favor of their own ways of doing things.

Of course there are numbers of men who find no difficulty in adapting themselves to almost any position or circumstances, but there are many more who do find difficulty in doing this, and it is wise to consider this fact when arrangements for new ventures are being made.

It is no reason for discouragement in starting new ventures, but it is a reason for caution and for efforts to avoid trouble arising from the fact that all men are not constructed upon the interchangeable plan, and that considerable trimming and interfitting may be required before things move as smoothly as they ought.

A Question of Custom, Perhaps.

Two or three years ago, more or less, a well-known mechanical engineer invented and patented a certain device that appeared to be very good indeed in connection with steam engine manufacture. One of the largest firms of steam engine manufacturers in the country adopted the improvement, and have since been paying for its use.

Recently, the inventor—who, by the way, is not an inventor by profession—finds that one of the great railroad companies of the country is using his invention without the courtesy of permission.

The different practice in the two cases is a matter of considerable importance to inventors. A manufacturer, if he wants to use the patented device of a man, will contract with him before using; it is too much the practice of railroad companies to use what they want without the ceremony of a contract. This may be more a matter of custom than of honesty, but it does not make much difference what name it goes by to the man who sees his property disappear without much hopes of recovery.

It is announced that suits for damages are to be brought against the members of the fishing and hunting club whose dam broke and caused the Johnstown disaster.

The members are reputed to be wealthy men, but their wealth, even if it were all to be taken, could, of course, never cover more than a fraction of the damage done. It will seem hard to many that men who, of course, supposed that no responsibility devolved upon them as individuals, so far as assuring themselves as to the safety of the dam was concerned, they naturally expecting the club officers to look after such matters, should be financially ruined. And yet the fact must be impressed upon the minds of those similarly situated, that some one must be held responsible for such things.

A decision by one of the courts of this city recently, if sustained elsewhere, would seem to leave precious little security for savings bank depositors.

In this case a depositor in one of the savings banks of New York City lost nearly $700, because a stranger presented the depositor's pass-book, answered the usual questions of the cashier, and signed the receipt, forging the depositor's name. The depositor sued for his money, and the judge directed a verdict for the bank. This, so far as we can see, makes the security of a deposit no greater than that which can be given to his pass-book by the depositor, any one securing possession of this book being able to get the money from the bank without the bank's being required to exercise ordinary care and vigilance to avoid paying to a forger.

In sharp contrast with this is the rule laid down by the courts for the regular banks. In these a depositor (who, by the way, is usually much better able to lose money than a savings bank depositor,) is perfectly secure against loss by forgery, the bank being held responsible for all such losses, even where the forgery is most skillfully planned and executed.

It seems that the rules of the United States inspectors do not allow for any difference of steam pressure on account of corrugated furnaces, but restrict them to the same pressure as for plain furnaces, notwithstanding they are known to be stronger. Acting in accordance with the rules, the pressure in the boilers of some of the Southern Pacific Steamship Company's vessels was reduced considerably below that for which the boilers and engines were designed, with the result of a loss of efficiency and sailing qualities.

Mr. Horace See, as consulting engineer for the company, has submitted a protest to the higher authorities in the matter, and the decision is awaited with considerable interest.

It is proposed to call the new practice ship, now building by Samuel L. Moore & Sons, at Elizabeth, the "George Bancroft," a name which, it is thought, will be peculiarly appropriate, for the reason that the Annapolis Naval Academy really owes its existence to Mr. Bancroft, who, while Secretary of the Navy, in 1845, collected at Annapolis midshipmen not on duty at sea. An unused military post there was used for their accommodation, and instructors were furnished for them, and paid for out of the current naval appropriations.

The plan worked well, and served as an object lesson for Congress. Appropriations were granted for its continuance and extension.

Literary Notes.

THE SLIDE RULE. By William Cox.

In this little book the manipulation of the slide rule is thoroughly explained, and any one wishing to become familiar with its operations and usefulness cannot do better than to obtain a copy. The author has devoted much time and study to the operations of the slide rule, and may be considered one of the best authorities on this subject.

He shows that the usefulness of the slide rule for facilitating the working out of complicated calculations is not confined to the engineer alone, but may be equally taken advantage of by the merchant, exporter, spinner, manufacturer, etc. Besides the description of the rule, the book contains numerous examples in multiplication, division, the extraction of roots of numbers, compound interest, trigonometrical computations, methods of working out mechanical and other formulas, including the method of finding the change wheels in a screw-cutting lathe, weight of iron bars, discharge from pumps, theoretical velocity of water for

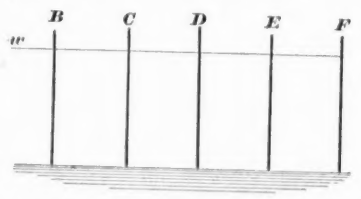
any head, horse-power of a turbine, horse-power of a steam engine, and many other computations of various kinds. The book contains thirty pages, and it is neatly gotten up. It is published by Keuffel & Esser Co., New York. Price, 50 cents.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(292) W. E. J., New Haven, Conn., writes: Please inform me what book, treating on mechanical drawing, is suitable for a beginner. I have all the materials needed to commence with, and all I need is an instructor. I have never taken but three lessons in drawing. I am learning to be a pattern maker, and want to get a thorough knowledge of drawing. *A.*—We believe that the articles on Practical Drawing, recently completed in the AMERICAN MACHINIST, will suit you.

(293) D. E. W., Middletown, Penn., writes: How much power will I save by making the following change of pulleys on three shafts. The first shaft is the crank-shaft; it runs at a speed of 80 revolutions per minute. A pulley 12 feet diameter on this shaft transmits motion by a belt to a pulley 4 feet diameter on shaft *A*; another pulley 2 feet diameter on shaft *A* transmits motion to a pulley 4 feet diameter on shaft *B*. The change I wish to make is to replace the 4 foot pulleys on the shafts *A* and *B* by 2-foot pulleys; and the 12-foot pulley on the crank-shaft is to be replaced by a pulley 3 feet diameter. *A.*—With the present arrangement the shaft *B* will make 120 revolutions; with the change of pulleys the shaft *B* will still make 120 revolutions, provided the speed of the engine is not changed. If, now, the resistance which the shaft *B* has to overcome remains the same as before, there will be neither a gain nor a loss of power, because the relative speed of crank-shaft and shaft *B* has not been changed.



(294) M. H. A., ——, Texas, writes: Please answer in your columns the following: A wire is fastened to the post *F*, and a wire stretcher is applied to the wire at *w*. A pull of 500 pounds is given to the wire, and it is then stapled to the post *B*, and afterwards it is stapled to the intermediate posts *C*, *D* and *E*. Query: Does the fastening of the wire to the intermediate posts *C*, *D* and *E*, lessen the strain on the extreme posts *B* and *F*? Or how much strain does each post sustain? *A.*—The weight of the wire will always cause the wire to sag, no matter how great a pull is applied to its end. If the intermediate posts do not bear any of the weight of the wire, or, in other words, if the sag is not taken up by fastening the wire to these posts, and it is simply prevented from swaying, the strain on the extreme posts will not be changed. But if the intermediate post bear some of the weight of the wire, so as to bring the wire nearer to a straight line, then the strain on the extreme posts will be reduced. The amount of reduction in this case will depend on the length of the wire, its elasticity and weight.

(295) G. K., Louisville, Ky., writes: Please give me a rule for finding the safe pressure on a disk of glass 3 inches diameter and $\frac{5}{8}$ thick. I have a cylinder 36 inches long, 18 inches diameter, closed up at each end; in the center of these ends, I want to place the glass disk. *A.*—The safe pressure which a disk not firmly fixed can sustain is found by the following formula:

$$p = \frac{6}{5} \times \frac{1{,}000 \times t^2}{r^2}; \qquad (1)$$

in which p denotes the pressure per square inch; t the thickness in inches; and r the radius in inches. According to this formula, the disk will sustain a pressure of 74 pounds per square inch. For a disk which is firmly fixed, the following formula is used;

$$p = \frac{3}{2} \times \frac{1{,}000 \times t^2}{r^2}. \qquad (2)$$

The letters in this formula represent the same data as before. According to this formula, the disk will sustain a pressure of 93 pounds per square inch. The constant 1,000 depends on the tenacity of the glass, and since this varies with the quality, and since the experiments for determining the tenacity of glass are not as numerous as those made with other materials, we should advise you to find the bursting pressure of the glass by actual tests before you put it to any extensive use.

(296) M. N. M., Woonsocket, R. I., writes: I should like to know what is the necessary information I should have, and where I can get books or papers giving the questions which will be asked when I apply for a license in New York. I am a machinist of ten years' experience on general all-around work; but I want to go to New York and get a job as engineer. I would like to prepare myself in advance by studying books treating on subjects with which I should be familiar. If it is necessary to have a knowledge of boilers and engines, please state what books I should study. *A.*—There are no regular sets of questions asked; the examination will be such as to determine your capability of taking charge of engines and boilers. To pass an examination you will require a fair knowledge of arithmetic, and of the construction of engines and boilers. It is difficult to recommend suitable books, as we do not know how far you have advanced in your studies, and what practical experience you have had. You can get a fair knowledge of boilers and their management from the Treatise on Steam Boilers, by R. Wilson; and to become familiar with the construction of engines, Elementary Manual of Steam and Steam Engine, by A. Jamieson, may be of assistance to you. These books you can obtain from any dealer in scientific works. You may find it necessary to engage as fireman so as to obtain the necessary experience in taking charge of engines and boilers. To become familiar with the duties of a fireman, probably Maxims and Instructions for the Boiler Room, by N. Hawkins, M. E., now being published in parts, will be of great assistance to you.

(297) B. B., Wilmington, Del., writes: Please give me a formula for computing the size and weight of a fly wheel, and al o a formula for computing the strength of spiral springs. *A.*—The diameter of a fly wheel is to a large extent arbitrary; the common proportion is to make the diameter of the wheel equal to three to four times the stroke. But it must be remembered that the rim velocity must be kept within certain limits to prevent rupture from the tension brought on by the centrifugal force, as an increase of section does not give increase of strength. Cast-iron is always more or less unreliable for tensile stress, and therefore it is usual to limit the rim velocity from 6,000 to 7,000 feet per minute if the rim be cast without a joint, and if jointed, to about 5,000 feet per minute; in some special cases these speeds are somewhat exceeded. It is impossible to formulate any precise rule for the weight of fly wheels; the weight must be such that the periodical fluctuations are insufficient to produce any detrimental effect on the character of the work performed, either directly or through disturbance of the action of the governor, or to be distinctly noticeable to the observer. But the amount of weight necessary to satisfy these conditions varies greatly with the nature of the machinery driven, some kinds assisting it more or less, and others being neutral in that respect, or even antagonistic. The following rule is often used, and will give equal efficacy for different diameters and speeds, and about the maximum requirement for any duty, except, perhaps, for rolling-mills, and similar extreme cases. Divide the constant number 12,000,000 by the square of the diameter of the wheel in feet, and also by the square of its revolutions per minute, and multiply the quotient by the area of the piston in square inches, and by its stroke in feet. The product will be the required weight of rim, assuming the engine properly loaded. For finding the load which a helical spring can sustain, the following formula may be used:

$$w = \frac{D^3 \times 3}{d}, \text{ for round steel.}$$

And

$$w = \frac{D^3 \times 4.29}{d}, \text{ for square steel.}$$

In which w denotes the load in pounds; d the diameter in inches of spring measured from center to center of the bar composing the spring; and D the diameter, or the side of the square of the steel bar of which the spring is made, in $\frac{1}{16}$ of an inch; if the diameter of the steel is $\frac{5}{8}$ inch, then $D = 6$; or if it is made of $\frac{5}{8}$ square steel, then D will also be equal to 6.

(298) E. S., New York, writes: I intend to make a steam tricycle. The wheels are to be 4 feet diameter; the boiler, 24 inches diameter, and 36 inches long. The fire-box is to extend half-way around the boiler; heating surface, 94 square feet; grate surface, 24x24 inches = 4 square feet. If, now, I use oil for fuel, and let the fire extend the whole length of boiler, there would be 6 square feet of fire surface. Now, what I would like to know, has oil the same evaporative power as coal? *A.*—The theoretical evaporative value of petroleum fuel and coal is given in the following table:

FUEL.	Heating power in British thermal units.	Theoretical evaporation in pounds of water per pound of fuel from and at 212° F.
Pennsylvania heavy crude oil	20,736	21.48
Caucasian light crude oil	22,027	22.79
Caucasian heavy crude oil	20,138	20.85
Petroleum refuse	19,832	20.53
Good English coal, mean of 98 samples	14,112	14.61

For a comparison, the theoretical evaporative power of petroleum may be taken at 16.2 pounds of water per pound of fuel, at an effective pressure of 120 pounds; and that of anthracite coal may be taken at 12.2 pounds of water per pound of fuel, at the same pressure. Now, in locomotive practice, a mean evaporation of from 7 to 7½ pounds of water per pound of anthracite is often obtained, thus giving about 60 per cent. of efficiency, while 40 per cent. of the heating power is unavoidably lost. But with petroleum an evaporation of 12.25 has been practically obtained, giving 75 per cent. efficiency. Hence the practical evaporative value of petroleum can be reckoned as at least from 63 to 75 per cent. higher than that of anthracite coal. 2. How can oil be best applied as fuel? *A.*—You will require a burner made for the purpose; there are a number of these on the market which have given good results, while some users have preferred to make their own, so that the selection of a satisfactory burner should not be a difficult matter. The common feature of all the burners is the injector or jet principle used with steam and hot air. Two methods of supplying oil to the burners are used, viz., by gravity from elevated tanks, and by pressure from tanks placed underneath. Both systems are in successful operation, and both have strong advocates. The keynote of the successful combustion of oil appears to be in the setting of the burner, and the arrangement of the furnace. The furnace should contain plenty of fire-brick surface, which, by becoming heated, will insure a complete combustion of the oil before the vapor or gases come in contact with the boiler. The burner should be set so that the oil vapor will be directed against this brick-work, and not against the boiler. Brick flues, so placed as to become highly heated, should be provided for supplying hot air to the burners. Generally, these requirements can be met by additions to the ordinary furnace, without disturbing it to such an extent as to render it difficult to return to the use of coal, if it should be desirable at any time. Illustrations of burners are given in our issues of April 7 and 14, and June 16, 1888. 3. The tricycle is driven by two upright engines 3x4 inches; mean effective pressure, 100 pounds; boiler pressure carried as high as 180 pounds, 200 pounds being the limit. Steam ports, 2x⅜ inches; exhaust ports, 2x¾ inches. What should be the capacity of oil tank? Will two cubic feet be sufficient for a run of 20 miles? *A.*—The capacity of the oil tank will depend much on the quality of the oil; but we believe that a capacity of one cubic foot will be ample. Your steam and exhaust ports are too large.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

George B. Grant—Gear Wheels. See p. 20.

Link-Belting and Sprocket Wheels.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla. N. Y. City Bolt & Nut Co., Limited.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Ice and Refrigerating Machines, 170 sold, and all successful. David Boyle, 521 Monroe St., Chicago, Ill.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

Crank Pin Machines. Pedrick & Ayer, Philadelphia, Pa.

Planer Chucks—Greenwood's Universal. Pedrick & Ayer, Philadelphia, Pa.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

$13.00 I. Dea L. Drawing Stands. The original. Send for postal. W. S. Rogers, Troy, N. Y.

To get the best work out of a Star Hack Saw, bear down heavily, and draw it very slowly.

S. A. Smith, 23 So. Canal St., Chicago, Ill., agent for Appleton Mfg. Co.'s Emery Grinding Machinery.

Grimshaw's Pump Catechism. $1.00 postpaid. Theo. Audel & Co., 91 Liberty st., N. Y. Catalogue.

Audubon Machine Works, New Haven, Conn. Electrical work, superior facilities. Builders of machinery, heavy and light.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

For the latest improved Eccentric Hook, Connecting Rods and Stub Ends, address T. C. Dill Machine Company, Philadelphia, Pa.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal St., Chicago, Western Agent.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

"Twenty Years With the Indicator," by Thomas Pray, Jr. 10,100 sold. Price, $2.50. Order of bookseller; take no other.

Our catalogue of books on all subjects, including books for machinists and engineers, sent free. Norman W. Henley & Co., 150 Nassau St., N. Y.

Self-adjusting Hand-Screw for Pattern and Cabinet Makers, Wood Workers, etc. Sample by mail for 50 cents. Wm. H. Denney, Lancaster, Pa.

N. Y. City Bolt & Nut Co., Limited, 33 and 35 Desbrosses St., N. Y. City, manufacturers of Machine Bolts of every description. Write for estimates.

Upright Drills and Iron Planers, for immediate delivery; prices reasonable. J. E. Snyder, Worcester, Mass.

25" 32" 37" 42" "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, Newark, N. J.

DuBois & DuBois, Patent Attys., 715 11th St., Washington, D. C., procure first-class patents. Send stamp for illustrated pamphlet, "March of Invention," containing valuable information, and list of references.

Every draftsman needs one. The Engineer's Sketch Book of mechanical movements, appliances, devices, contrivances, etc., by T. W. Barber. 1,936 illustrations, 8vo., cloth, $3. Catalogue of books on mech. subjects free. E. & F. N. Spon, 12 Cortlandt St., New York.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Club Rates.—If no one is getting up a club for the AMERICAN MACHINIST in your town or establishment, send for Circular of New Club Rates, and try it yourself. Address AMERICAN MACHINIST, 96 Fulton St., New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York

MANUFACTURES.

Newton, N. C., is to have another cotton mill, it is reported.

The Russellville (Ky.) Iron Foundry is to be put in operation.

J. C. King is reported as erecting a cotton-mill at Anniston, Ala.

M. Osborn is to add new machinery to his mill at Bloomingdale, Wis.

The plant of the Donaldson Iron Company, Emaus, Pa., is to be increased.

The establishment of an electric light plant is talked of at Scotland Neck, N. C.

The manufacture of an improved air-brake has been established in Carthage, N. Y.

The Smith Paper Company, of Lee, Mass., contemplates adding machinery to its plant.

At New Lewisville, Ark., efforts are being made for the establishment of an iron foundry.

Wallace, Banfield & Co. are to add a new cold rolling-mill to their plant at Irondale, Pa.

The Whittier Machine Company, of Boston, are to have a new shop erected, to be 116x75 feet.

An Eastern capitalist is reported as endeavoring to establish a Chinese silk factory at El Paso, Tex.

Lucadoe & Hager will, it is reported, put new machinery in their iron foundry at Glen Elk, W. Va.

The King's Mountain (N. C.) Manufacturing Company will double the capacity of its cotton-mill.

The Merchants Manufacturing Company is to put in new boilers at its cotton-mill, Fall River, Mass.

It is reported that the Thornton Worsted Company, Thornton, R. I., is to increase the size of its plant.

A factory is to be erected by Snope Bros. at Gordonsville, Va., to manufacture fancy cotton goods.

It is rumored that Eastern parties will organize a stock company, to erect a steel plant, in Wheeling, W. Va.

The Bliss Cotton Hardware Company, Denver, Colo., has been incorporated, with a capital of $10,000.

The Griffin (Ga.) Ice Company is reported as to put in new machinery to increase the capacity of its ice factory.

The Georgia Manufacturing Company, White Hall, La., is reported as to put new machinery in its cotton-mill.

J. B. Pyron, of Cincinnati, Ohio, is organizing a $100,000 stock company, to erect a cotton-mill at Collinsville, Ala.

Negotiations are now pending for a new steel plant to be erected at Mendelssohn, Pa., in the Monongahela Valley.

The Hendrick Manufacturing Company, of Carbondale, Pa., have broken ground for a new machine shop 140x40 feet.

Combs & Brown, machinists, at Woburn, Mass., are building at Haverhill, and expect to move their business there in July.

The Pitman Manufacturing Company, of Laconia, N. H., will soon begin the erection of new buildings at a cost of $20,000.

The Cumberland and Unaka Iron and Steel Company have been organized at Knoxville, Tenn., and will erect a plant at once.

It is stated that Watts Bros., Middlesborough, Ky., will add a Bessemer plant to their steel works, at a cost of nearly $500,000.

A stock company is being organized, it is reported, by N. B. Smith and others, to establish a cotton factory at Grover, N. C.

A new foundry and machine shop is to be erected at Hillsborough Bridge, N. H., and a good business has already been guaranteed it.

Williams, White & Co., Moline, Ill., have issued a new catalogue of "Builldozers" hammers, drop presses, dies, tire setters, etc., etc.

New machinery is to be placed in the Nazareth (Pa.) Manufacturing Company's plant for the manufacture of jersey underwear.

A new dyehouse is to be erected by the Manchester Cotton-mills, Fort Worth, Tex. New spinning machinery will also be added.

The Knoxville Iron Company, of Knoxville, Tenn., will rebuild its machine shops and bolt department, which were recently burned.

The Marshallville (Ga.) Manufacturing and Improvement Company contemplates the erection of an iron foundry and machine shops.

The manufacture of iron furnaces is an enterprise to be established at Queen City, Tex., under the management of an English syndicate.

The Sands Automatic Fan Company has filed in the Secretary of State's office a certificate of removal from Meriden to Bridgeport, Conn.

The Mosler Safe and Lock Company, of Cincinnati, Ohio, is investigating with a view of establishing a branch safe works in Chattanooga, Tenn.

The Graham Wrench and Drop Forging Company, of Buffalo, N. Y., has been incorporated, to manufacture a new pipe wrench; capital, $40,000.

A movement is on foot at Scranton, Pa., to build a wire-drawing plant and nail factory. James Nolan is mentioned as the originator of the enterprise.

The Farrell Foundry and Machine Company, Waterbury, Conn., will begin work soon on a new machine shop, 100x100 feet, one and two stories in height.

The foundation work for the Smith & Briggs Brass Company, maker of plumber supplies, at Buchanan, Va., has been begun, and is being pushed rapidly.

The Globe File and Hardware Company has been incorporated at St. Louis, Mo., with a capital of $20,000. Stockholders: C. H. Niekamp, C. J. Becker and A. O. Rule.

A new building, to be equipped with machinery, is to be added to the plant of J. M. Robins & Co., manufacturers of special metal-working machinery, at Cincinnati, O.

The South Pittsburg City Company is, through its agent in England, endeavoring to organize a stock company to construct a steel plant at South Pittsburg, Tenn.

Messrs. A. J. Sweeney & Son, of Wheeling, W. Va., manufacturers of all kinds of machinery, have contracted with the city of Staunton, Va., to remove their plant to that place.

The John E. Beggs Machinery and Supply Company have filed articles of incorporation at Paterson, N. J. The capital stock of the company is $25,000, of which $10,000 is paid in.

The Pulaski Knitting-mills Company, Savannah, Ga., has organized, with W. W. Williamson as president. It has leased a building, and will put in machinery at once. Capital, $50,000.

The Mason-Perkins Manufacturing Company, Bristol, N. H., has begun work on the foundation for an extension to its machine-room, and will shut down about July 1, to complete the work.

The Automatic Knife Company has been incorporated, with a capital stock of $25,000, and will erect a factory at Cananoque, Ont., for the manufacture of a patent automatic pocket knife.

It is stated that the Alleghany Mining and Development Company has authorized its executive committee to close contract for the erection of a rolling-mill and nail-mill in Clifton Forge, Va.

The Railway Supply Foundry Company, of Chicago, Ill., has been incorporated, with capital stock of $60,000, for general manufacturing; incorporators, Irwin Veeder, W. M. Rheem and O. R. Barnett.

It is proposed to organize a stock company at Knoxville, Tenn., to promote the establishment of small industries, and erect a plant to furnish power for same. W. H. Greers can give further particulars.

The National Malleable Iron Company, of Peoria, Ill., has been incorporated, to manufacture malleable iron and machinery; capital, $100,000. Incorporators: A. Henry, A. C. Angler and Geo. A. Wilson.

The Defiance Machine Works, of Defiance, Ohio, builders of patent wood-working machinery, have just completed a very fine fire-proof pattern house 60x80 feet, to be used exclusively for the storing of patterns.

Messrs. I. Matheson & Co., New Glasgow, N. S., are building a 150x75 feet addition to their works, to be used in the construction of steam boilers. This concern is a large manufacturer of mining machinery.

Operations on the buildings and furnaces of the Damascus Steel Works, to be erected at Denver, Col., are to begin as soon as a site is decided upon, which it is expected will be within a week. Work will be pushed.

The Atlanta Iron and Steel Casting Company, recently organized at Atlanta, Ga., expects to build a plant for making steel castings and other kinds of steel, and is now preparing plans. Edward Van Winkle is president.

Merchant & Co., Philadelphia, Pa., have issued a new illustrated catalogue of the Star Ventilator, for the ventilation of all kinds of buildings. The illustrations show the application of the ventilator and its construction.

The stock company recently organized by W. A Rinehart and others, to erect an iron foundry and machine shop at Covington, Va., has been incorporated as the Covington Machine Company, with a capital stock of $500,000.

The Huntington (Ark.) Cotton-mills Company has been incorporated, with A. G. Raymond, president; L. Godfrey, vice president, and E. W. Ross, secretary, to erect a cotton, cloth and yarn-mill of 8,000 spindles; capital stock, $150,000.

George Riddick and others, of Anderson, Ind., have, it is stated, organized the Hygeia Ice Company, and will erect an ice factory in Norfolk, Va., and sink artesian wells for water supply; capacity of factory to be 60 to 90 tons per day.

An Ohio party is corresponding with the Big Stone Gap (Va.) Improvement Co. relative to the establishment there of foundry and machine shops, rolling-mill electrical works, two glass factories, and other manufacturing industries.

The $100,000 stock company lately organized to erect a nut and bolt factory at Curtis Bay (P. O. Baltimore), Md., has been incorporated as the Maryland Bolt and Nut Company, by D. L. Bartlett, J. O. Norris, A. Von Lingen and others.

Messrs. R. Vogel, C. J. Steiner and Fred Hessler, of Chicago, have incorporated the Railway and Construction Company, with capital stock of $100,000. The business of the company will be the survey and construction of railway lines.

A company has been formed at New Albany, Ind., with sufficient capital for operating the steam forge and rolling-mill, which recently suspended operations at that point. Operations will begin at once on a much larger scale than heretofore.

The stock company recently organized by W. A. White and others to erect iron foundry and machine shops at West Point, Miss., has been incorporated as the West Point Foundry and Machine Shops, with an authorized capital stock of $12,000.

There is water-works agitation in Sheldon, Iowa; Wall Lake, Iowa; Easthampton, Mass.; Woonsocket, R. I.; Bristol, Pa.; San Francisco, Cal.; Madelia, Minn.; New Britain, Conn.; Napoleon, Ohio; Rockdale, Texas; Roodhouse, Ill.; Zanesville, Ohio.

Concord (N. H.) capitalists have formed a company to engage in the manufacture of incandescent light dynamos, power plants, railway motors and storage batteries, which are the inventions of J. H. Showhan, who recently moved to that city from Detroit, Mich.

A fire at the Missouri Car and Foundry Company's works, St. Louis, Mo., last week, destroyed the blacksmith and machine shops, entailing a loss of about $15,000. The shops will be immediately rebuilt, and the machinery destroyed, duplicated as quickly as possible.

The Berry & Orton Co., of Philadelphia, manufacturers of car builders' tools, are to build a large five-story brick factory, situated on the corner of 23d and Arch streets. They hope when it is completed to fill all orders promptly. They are at present behind their orders.

The foundry plant at Quakertown, Pa., consisting of foundry, machine shop, warehouses, etc., has been purchased by a syndicate of capitalists, consisting of J. R. Wood, S. H. Morgan, John Hillegas, Charles Smith, Cornelius Burnside, George Yost and Francis Sanders.

The Southern Queen Manufacturing Company has organized at East Chattanooga, Tenn., with T. A. Snow, president, and C. A. Williard, secretary and treasurer. The company proposes to erect foundry and machine shops for the manufacture of the Southern Queen range.

The Midvale Steel Company, Nicetown, Philadelphia, have recently increased facilities, and are now prepared to make steel castings and forgings of the heaviest description. This company has furnished ordnance material to the United States government for several years past.

The Maryland Tube and Iron Works has been incorporated, with H. O. Chapman, of Philadelphia, Pa., as president; J. B. Hayes, of Norristown, Pa., vice-president, and O. C. Knipe, of same place, secretary, to establish pipe works at Hagerstown, Md. The capital stock is $60,000.

Enright & Johnes have succeeded George S. Davison and Davison & Briggs, starting in business at 61 Market street, near Market street depot, Newark, N. J. They will build and repair ice and refrigerating machines and appliances, and other machinery, and do a general steam engineering business.

The Hill Machine Company has been reorganized at Florence, Mass., with a capital of $100,000, and these officers: President, A. G. Hill; vice-president, Max Ulrich; treasurer and manager, C. H. Clute. It is proposed to erect new shops at once for the manufacture of the Ulrich steam engine, and plans are now being drawn.

The East Lebanon Iron Company have been formed at East Lebanon, Pa., to erect a rolling-mill at that place. The capital of the company is $100,000. N. E. Legat is president, and the remainder of the directory is composed of H. O. Nully, James E. Legat, J. R. Beckley, Daniel S. Light, J. B. Irish and H. T. Atkins.

The capital stock of the Ticonderoga Machine Company, Ticonderoga, N. Y., has been increased from $30,000 to $125,000, and an addition is being built to the old machine shop, which will be 144x80 feet. The building will be of brick, and equipped with the most modern machinery for the manufacture of mining machinery and gas engines.

The new safe and lock works which are to be erected at Elizabeth, N. J., have been duly organized, with a capital stock of $200,000. They elected J. R. Wylie as treasurer, and C. H. Underwood, E. W. Neff, J. T. Hough, J. B. Sheriff Jas. H. Graham, W. C. Voigt, and John Collier as directors. The company will be known as the American Vault, Safe and Lock Company.

The new tin plate building of the St. Louis Stamping Company, St. Louis, Mo., is rapidly nearing completion. It was thought the plant would be ready for operation by the 1st of July, but work will not begin so soon. The machinery will be placed as soon as the building is finished, but the building of the furnaces is a time-taking operation, so that it is very probable that the works will not be ready to operate for two months.

The Canonsburg Iron and Steel Company, of Pittsburgh, manufacturers of fine sheet iron and sheet steel, and whose plant is located at Canonsburg, Pa., have recently decided to add an additional sheet-mill to their equipment. They are now negotiating for the necessary machinery. Everything connected with the new mill will be of the most modern design, and when completed, the capacity of their plant will be increased one-third of the present amount.

Landis Bros., tool builders, of Waynesboro, Pa., are about putting up new shops on a site on the main line of the Baltimore & Cumberland Valley R. R., at the same place, to consist of a machine shop and foundry with modern improvements. They are having a steadily growing trade for their grinding machines, having recently exported two machines; one each to Switzerland and Belgium. They contemplate adding several new tools to their manufacture in the near future.

George E. Downing, of South Pittsburg, Tenn., and associates have been donated a site to erect an open hearth basic steel works. Construction will commence at an early date on furnaces and rolling-mill. An agent is in England raising necessary capital for another plant of the same character. The town has also promised to donate a site to another company of Tennessee and eastern people for the erection of blast furnaces, steel plant and rolling-mill. Other small plants are negotiating for sites, etc.

The Weston Engine Company, Painted Post, N. Y., write us: "We expect to open an office in your city, July 1st, at 40 Cortlandt street, under the style of Messrs. Julian Scholl & Co., for the purpose of handling our engines in your market. We will soon send you our new illustrated catalogue, which we think will compare with any in the whirl of business maze, not only in appearance, but for the goods it represents. We have recently added a new governor to our engine, which is going to send it to the front, as we can guarantee as close regulation as any automatic engine on the market."

The Penberthy Injector Company, Detroit, Mich., sent a full line of injectors to the chemical and physical laboratory of J. F. Elsom, of New Albany, Ind., the object being to ascertain their efficiency as boiler feeders. The following is from one of the sheets, and is copied from the original report by Mr. Elsom: 'Injector B. Attention after starting, none; Pressure on gauge, 85 pounds; Lift, 4 feet 2 inches; Temperature without heater, 150° Fahr.; Temperature with heater, 207.5° Fahr.; Amount of water moved, 256.2 gallons; Time, 60 minutes; Efficiency, geared pump from engine as unity, 99.2 per cent."

A Suggestion for Flooring a Machinery Hall for Exhibition Purposes.

BY JOHN HEDSON.

Among all the disagreeable things connected with an exhibition, both for the authorities in charge and the exhibitors, are the delays before the opening and after the closing of the exhibition.

The cause of the delay in opening is due to the fact that exhibitors do not ship and get their exhibits on the ground on time, and difficulties in unloading and depositing the goods in their proper places. The attempt is made at each exhibition to improve on this, by insisting that the goods shall be shipped a considerable time before the opening, and this time is made longer and longer at each succeeding exhibition, with the result that the delays become worse. The writer believes that this delay on the part of the exhibition could be better prevented by the explicit statement to each exhibitor that unless his goods are shipped on a certain day there will be no certificate issued to secure free return freight, nor the appropriated space reserved.

A difficulty exists in handling the goods when received at the building. It is evident from the arrangement of every freight station in the country that it is desirable to have the platform level with the floor of freight cars, hence, so far as the handling of the goods is concerned, no one will question that it would be better to have the floor of Machinery Hall, or, in fact, nearly every other exhibition building up to car floor height from the railroad tracks, which tracks should be laid through all the main aisles of every building. To point out how a floor can be constructed to meet this and other desirable conditions is the object of this paper.

Build cross walls or cross lines of piers, seven feet from center to center, of such a height that when 12" timbers and the floor are laid the top of the floor will be at the proper height. Lay the stringers or sills, of either long 10x12 timbers, or of two thicknesses of 6x10 pieces, 14, 21, or 28 feet in length, breaking joints so that no splicing will be required, then lay the floor entirely of pieces 6"x10" by 7 feet long, all pieces throughout the entire floor to be alike, and heavy enough to stay without nailing. Such a floor, level with the cars, will be easy to unload upon, and strong enough to hold all machinery, except where foundations are necessary. Where it is necessary to build foundations any one piece of the floor can be picked up by a pair of screw handles, and the opening readily increased to any extent. After the foundations are laid, the patching, such as cannot be filled by the standard pieces of flooring, can be pieced out by plank. When admission of the cars is stopped, the track spaces, which are then to form the aisles, can be floored over the same as the other parts. There will be ample space below for pipes of all kinds, accessible at all points, and also space for every exhibitor to store his own packing cases, which, if too large, can be made in knock-down form. This will avoid a monstrous nuisance at the opening of the exhibition, and the waiting of from one to fifteen days at the close to get the packing cases, which heretofore have been the most troublesome things to deal with. Admirable as was the plan at the Centennial, the packing cases were so piled one upon another, and there were so many long delays and general smash-ups as to make things anything but pleasant. Great piles had to be overhauled and brought in through the rain and sleet, whereas the proposed plan would make each exhibitor master of the packing case situation. The arrangement of the floor would be even more advantageous for shipping than for receiving, and when the goods were all removed the floor itself could be easily loaded, and every piece become a seasoned railroad tie worth more than when laid in the floor.

There is one objection, and that quite serious, but one that can be partly overcome, so as to leave it on the endurable side. The objection is that during the days of placing

and removing the exhibits, the railway tracks make long canals through the buildings, which cannot be crossed without climbing down and up; by throwing light plank bridges across, or by supplying, for the use of spry young men, hanging ropes from which they could swing across with ease, the objection will be modified.

Although it is too late to make this suggestion available at Chicago, it may be in other cases, provided there are not objections so great as to overbalance the advantages.

To exhibitors who have suffered the experience, no hints are necessary; but to others who are contemplating making an extensive exhibit at Chicago the suggestion is made, that now is the time to begin to think about it. Let each say to himself that if the exhibition is to open on the 1st of May, '93, and there is any delay, it shall not be my fault. Do not gamble on the prediction that the buildings will not be ready. Plan your exhibit in advance; have a place set apart in your establishment the size of the space you have allotted to you; arrange your exhibit as you expect to have it, and to settle on that call in an artist and ask him to tell you what clap trap and monkey shines to leave at home. Note what tools and traps you have needed to erect the exhibit and take them all with you. If you have any foundation to build or carpenter work to do, take your own mason and carpenter and their tools with you, not only because it will be cheaper, but because it will avoid delay. The best packing cases of large size, and in the end the cheapest, are those made by grooving the ends into the bottom, top and sides as the heads of a barrel are grooved in, and then hoop the ends of the boxes with band iron hoops welded. Arrange it so the small boxes will go inside the large ones.

If exhibitors would find out who their neighbors were to be and club together and employ a designer to arrange the display, so that the result will be a harmonious whole, rather than for each to go in on his own hook, and find himself an extinguished unit in a sea of confusion, the result would be much more creditable.

A concern may be a large factor in a neighborhood, but a small one in a nation; as a nation may be great in its own estimation and shrink wonderfully when surrounded by others.

A Belt Dynamometer.

BY S. P. WATT, CINCINNATI, OHIO.

(Presented at the Providence Meeting of Mechanical Engineers.)

The dynamometer here presented (Fig. 221) consists of a set of pulleys mounted on a suitable frame and disposed as follows: The pulleys A and C are fixed to the shaft a; B and D are fixed to the shaft b. The pulleys E and F revolve freely, as independent loose pulleys on the shaft g. The shaft g has a second shaft f, fixed to it midway between the pulleys E and F. Shaft f constitutes a pivoting axis, parallel to the shafts a and b, for the shaft g, together with the frame K and the weight lever L, all rigidly connected. Only enough motion of L is allowed to determine the direction of action. Instead of the weight on the lever L, the end of the lever could be connected to a small platform scale and its tendency to rotate weighed. It might be useful to make the frame between the pulleys adjustable at d and e in order to vary the tension of the dynamometer belt, or, better still, it might be so constructed that the absolute tension could be noted at any time, whether working or at rest. The working of the apparatus is as follows: A driving belt from the source of power is put on the pulley A. The machine to be driven is belted from the pulley B. The dynamometer belt passes from the lower side of the pulley C to the pulley F, around F to D, around D to E, around E back to C. It will be seen that C is a driving pulley, and D a driven pulley. When the system is at rest the four strands of the dynamometer belt have the same tension. If, now, C revolve and drive D, the tension T_1 of the belt from C around the loose pulley F to D will correspond to the tension of the taut side in a simple system of two pulleys, and the tension T_2 of the belt from the lower side of D around F back to the lower side of C will correspond to the slack side.

The difference of tension is the driving pressure P, and taking what actually occurs we have:

$$\frac{2\ T_1 - 2\ T_2}{2} = T_1 - T_2 = P.$$

Now P in pounds multiplied by the speed of the belt is foot-pounds developed or consumed, ignoring friction. Let r be the radius of the position of pulleys E and F from the pivot f. Let l be the distance of the weight W from f, to balance the tendency of the frame K to rotate about f when working, then:

$$Wl = r(2\,T_1 - 2\,T_2) \text{ or } \frac{Wl}{2\,r} = T_1 - T_2 = P.$$

It is evident that should a Prony brake be put in place of the pulley B the power developed by the motor to A could be determined. If a machine be driven from the pulley B, the power consumed could also be noted in the speed of belt and the position of the weight from the same formula. In the use of different belts as dynamometer belts, the relative efficiency of such belts can readily be determined by the use of the brake attachment. It will also be seen that but one side of the belt comes in contact with the pulleys.

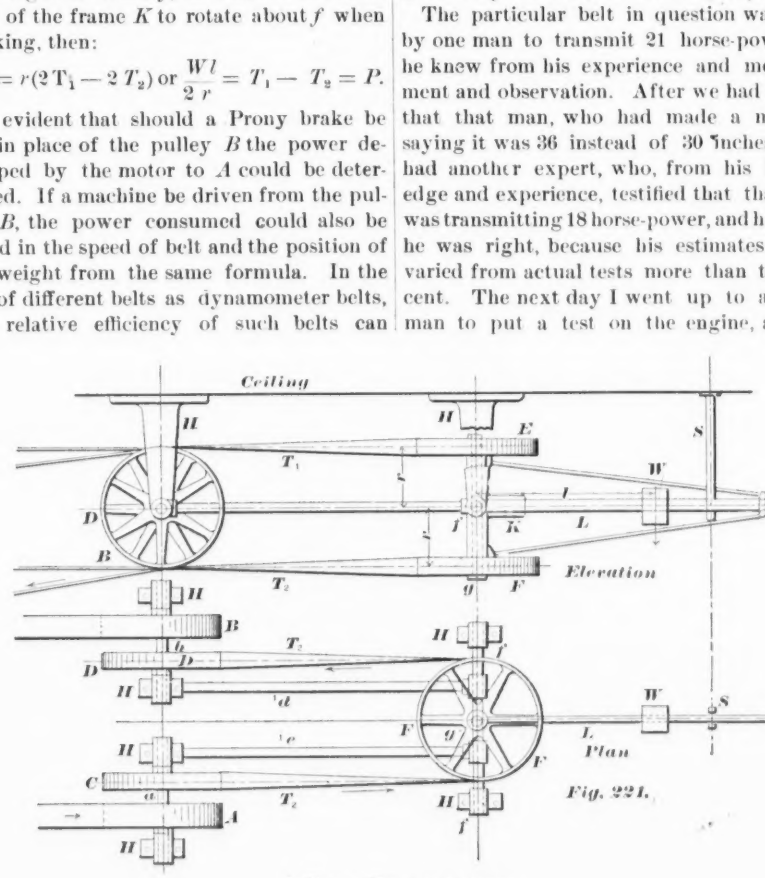


Fig. 221.

A BELT DYNAMOMETER.

DISCUSSION.

MR. WILLIAM KENT: I am especially interested in the result of dynamometers now, for the reason that we have used one or two, and have been engaged in a lawsuit, in which it has been sworn to by a member of this society—and I am glad to say he is not now a member of it—that they are of no use, and that the only way to measure the horse-power was to measure the belt (laughter), and that it wasn't a proper way of telling the horse-power. I would like to hold that man up as a terrible example for this society. I hope no other member of this society will ever have the temerity to get on the witness stand and say such a thing as that. So, Mr. President, I am very anxious to get on record actual records of dynamometers. We have had discussions of this matter in the society before, and the chief thing we had to bring in opposition to this expert was to show that those whom we recognized as experts on belts, we referred to papers they had written in the society, and found that those experts were confessing that they didn't know very much about belts anyway.

The particular belt in question was said by one man to transmit 21 horse-power, as he knew from his experience and measurement and observation. After we had shown that that man, who had made a mistake saying it was 36 instead of 30 inches, they had another expert, who, from his knowledge and experience, testified that that belt was transmitting 18 horse-power, and he knew he was right, because his estimates never varied from actual tests more than ten per cent. The next day I went up to another man to put a test on the engine, and we found that that belt could not transmit over seven horse-power. Two years before it had been tested, and found to be transmitting seven and a quarter horse-power. So that the difference between testing by a pony brake and guessing runs all the way from 7 to 21 horse-power. (Laughter.) The moral is: Don't you guess what a belt is transmitting, because you nearly always guess too much.

The San Francisco *Chronicle* of June 7 contains a most elaborate article on the subject of irrigation, in which the history of artificial water supply in this and other countries is reviewed, and its great advantages fully set forth. It is declared that the subject of irrigation is second to no other in importance to the State of California, gold mining not excepted.

Universal Pipe Hanger.

The engravings presented herewith show a new pipe hanger, in which provision has been made for the effects of expansion and movement of the pipe laterally as well as endwise. It is well known that when a long line of pipe is expanded by heat there is usually more or less tendency to move sideways, which, if resisted, may cause trouble. This hanger allows for such movement by means of the universal joint which is interposed between the stud or lag-screw, and the ring which encircles the pipe. The engraving makes the construction of the hanger very plain, and it will be noticed that it can be applied after the pipe is in position by means of the bolt which passes through the yoke or universal joint.

The lower end of the lag-screw is provided with a regular pipe thread, so that, by means of a coupling and piece of pipe, it can be extended to any desired length.

The hanger is simple, strong, easily put up, and is well calculated to overcome some of the difficulties encountered with steam pipes.

Where desired, the lag-screw is replaced by a clamp for an iron beam, as shown. They are made in all sizes for pipes ½" to 14" diameter, by E. Rutzler, 178 Centre street, New York City.

UNIVERSAL PIPE HANGER.

It is often reasoned that men cannot start in manufacturing business in a small way, as they could twenty-five years ago, with any prospects of success, the large corporations being able, and disposed, to crush them. This is probably true, to some extent, but not to the extent generally believed. By spreading his energy over little space, the small manufacturer is often able to compete with the large one, who is generally handicapped with more or less of unwieldiness. In the machine business, for example, the small shop is in the process of growing into the large one, in just about the same old-fashioned way as ever. In fact, there were probably never more instances of this than there are to-day. Concentrated energy is a potent factor in this.

"Burning Smoke" is not such a modern idea as many suppose. In a book on the steam engine, printed more than sixty years ago, is the following: "There are cases in which it is of advantage to burn the smoke that issues from furnaces. As, however, when the fire is properly managed but little unconsumed matter will issue from a furnace of the ordinary construction, such plans are of very little value in making the heat produced by a given quantity of fuel greater. It is only then, when the smoke that occasionally issues when fuel is just added is productive of inconvenience to the neighborhood that furnaces of the kind [for burning smoke] need be erected."

Machinists' Supplies and Iron.

NEW YORK, June 27, 1891.

Iron—American Pig—The market is steady and there is a moderate amount of business being done.

We quote: No. 1 Foundry, Standard Northern brands, $17 to $18; No. 2 is selling at $16 to $17, and Gray Forge at $13.90 to $14.50. Southern brands of good quality are obtainable at $16 to $17.50 for No. 1 Foundry; and $15.75 to $16 for No. 2; and $14 to $14.50 for No. 3.

Scotch Pig—We quote at $24.50 for Coltness; $22 for Dalmellington; and $20.50 for Eglington.

Copper—Prices are steady, but little business is being done, as the demand for consumption continues light. Actual values are under the circumstances difficult to determine, but there are bids at 12¾c. to 12.80c. for spot, while holders' prices are somewhat above 13c.

Lead—There has been very little business done on account of failure to agree as to prices. Values in car lots are at 4.40c. to 4.50c.

Spelter—The market is somewhat unsteady, but with a tendency to firmer prices, though there is little if any improvement in demand. Values are at 5c. to 5.05c.

Tin—The market continues quiet, but prices are firmly maintained at 20.50c. to 20.70c. for spot.

Antimony—The market is dull and prices weak. We quote Hallett's at 13c. to 13¼c.; Cookson's, 14½c. to 15c.; and 13½c. for X. L.

Lard Oil—Prices are maintained at 52c. to 53c. for City, Western at 51c.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Agents wanted in every shop for fine surface gauges. Address E. G. Smith, Columbia, Pa.

Wanted — Progressive, energetic machinist, as foreman in bicycle factory. Mfr., AM. MACHINIST.

A young mechanical draftsman, with excellent refs., wishes a position. Permanent, AM. MACH.

Experienced molder, with $3,000, to take a one-half interest in a well established western foundry and machine shop. Address Box 12, AM. MACH.

A first-class tool maker, well posted on automatic machines, wants situation to keep them in order, or to build new ones. Address BOX 9, AM. MACHINIST.

Mechanical draftsman and designer of 10 years' American practice wants position or take charge of drawing office. "Camera," AM. MACHINIST.

Wanted—A general blacksmith, good, all-round man; good wages. Apply to the Merrill-Stevens Eng. Co., Jacksonville, Fla.

Foundry foreman is open for engagement; light or heavy work. 17 years' experience; ample references. Western State preferred. Box 11, AM. MACH.

Draftsman who is familiar with engine work, general machinery and designing, desires a position. Address "Lilly," 351 Rookery, Chicago.

Wanted—Situation by a technical graduate who has had 8 years of practical experience; age 25. Address D. E., AMERICAN MACHINIST.

The superintendent of a boiler works, who is a prac. man and accustomed to all classes of work, is desirous of changing, & invites correspondence for his services. Loco. work preferred. Supt., AM. MACH.

Wanted—First-class mechanical draftsman; apply, stating experience, and wages expected, to Edison General Electric Co., Canadian Works, Peterborough, Canada.

Wanted — A bang-up machinist with money, fully competent to take charge of a 50 hand shop on light interchangeable work, and let me go on the road. Address Box 170, Baltimore, Md.

Wanted—A position as brass foundry foreman; have a thorough practical and scientific knowledge of mixing and alloying all the new bronzes, brasses and white metals; also molding of both heavy and light work in all its details. Address C. W. Pine, 24 Dudley street, Cincinnati, Ohio.

Wanted—Position as supt. or foreman, by a young man, 36, successful in the systematic manufacture of machinery and mechanical devices, and in the economical management of men; a designer and draftsman of automatic and interchangeable machinery, tools, jigs, etc. W. H. S., Box 197, Burnside, Conn.

Wanted—In the vicinity of New York City, a position as draftsman or superintendent by a young man having a technical education. 13 years' experience as a pattern maker, draftsman and machinist. Expert in handling men to an advantage. References. R. B., care Mrs. R. Henn, 115 Nassau Avenue, Brooklyn.

A young married engineer, resident of Bloomfield, wishes engag't in Newark or vicinity. Has occupied positions as draftsman & constructing eng'r in New York for some years past. Having served his time and worked in a marine engineering shop, will also take prac. charge of shop, large or small; only moderate salary expected. Refs & recommendations in personal interview. C. C. T., Bloomfield, N. J.

Position by first-class millwright understanding all details of factory buildings, engines and machinery. Age, 37; 18 years' experience, 10 years as foreman. J. A. V., Station "G," Brooklyn, N. Y.

Wanted—At Pittsburgh Locomotive Works, Pittsburgh, Pa., a competent foundryman to take charge of iron and brass foundries; must be active, entirely temperate, and thoroughly understand locomotive work; state salary expected, and give references.

Wanted—A sober, energetic young man, good engineer and machinist, who can operate a Miller & Bierce steam and hydraulic cotton compress successfully; also take charge of labor around the compress, commencing August 15th inst.; salary $75 per month. Address, with references, Union Compress & Warehouse Co., Macon, Ga.

Wanted—By a western technical school, an instructor in pattern making and wood work, one capable of organizing and directing a systematic course of training; also a brass molder thoroughly posted in the various branches of foundry practice, and capable of giving instruction in same. Address, with references, A. W. Bradley, AM. MACHINIST.

Situation Wanted—A foundry foreman of several years' exp. in a couple of the best shops in the U S., and capable of handling men to an advantage, and taking charge of the most difficult work in either loam, dry or green sand, will be open for an engagement after July 1st. Best of references furnished. Address Box 4, AMERICAN MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d hd-lathes & planers. S. M. York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

Special leather and cement for covering pulleys; no rivets required; local agents wanted. Crescent Mfg. Company, Cleveland, Ohio.

Engine for sale; 55 H. P. Watts-Campbell slide valve engine in good order; will be sold cheap. F. Berg & Co., Orange Valley, N. J.

One Wright automatic engine for sale, in good condition; cylinders 15"x32". Can be seen at 251 Greenpoint avenue, Brooklyn.

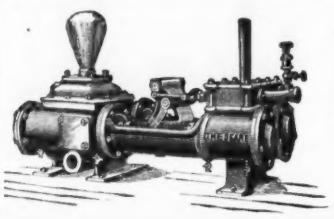
Wanted—Agents for Mechanics' Reference Book of Practical Rules and Tables. All mechanics should send 15 cents for this book. Address Summit Pub. Co., Akron, O., Box 40.

For Sale—Three 3-ton jib cranes. 20 ft. height of mast, swing in space of 35 ft. Can be seen in position until July 15th at works of The J. Morton Poole Co., Wilmington, Del.

Wanted—Two practical machinists to take half interest in foundry and machine shops, having excellent facilities for doing good work, manufacturing and jobbing. P. M. Trumbower, Muncy, Pa.

Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

Wanted—Wm. Rontree, engineer, who was employed in our works during 1886 and 1887, will hear of something to his advantage by addressing us at once. Any information of the above will be thankfully received at the Fulton Iron Works, Second and Carr streets, St. Louis, Mo.



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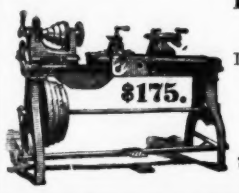

Improved Screw Cutting Foot and Power. LATHES
Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
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167 to 175 Highland Avenue, SIDNEY, OHIO.
MONTGOMERY & CO., 105 Fulton St., New York, Gen'l Agents.

FINE TAPS, DIES, REAMERS, Etc.

LIGHTNING AND GREEN RIVER SCREW PLATES.
Bolt Cutters, Hand and Power Drilling Machines, Punching Presses, Tire Benders, Tire Upsetters and Other Labor-Saving Tools Send for Price List.
WILEY & RUSSELL MFG. CO., GREENFIELD, MASS. New York Agency, No. 126 Liberty St.

PRACTICALLY DEMONSTRATED.
THE HACKNEY POWER HAMMER
is meeting with DESERVED SUCCESS, and an investigation as to its principle of operation and construction will convince any one beyond question of its superiority in every respect over the old-fashioned-helve-rubber cushioned-leather strap-awkward belt tightener power hammers sold to-day. All such old fogy and frail appliances are done away with in the "HACKNEY," and the purchaser gets for his money a vastly more EFFECTIVE and DURABLE HAMMER.
That the "HACKNEY" is far ahead of any other power hammer in the market is PRACTICALLY DEMONSTRATED, and we have strong testimonial letters from leading firms throughout the country who have used them.
Write for Illustrated Catalogue with Description and Prices.
THE HACKNEY HAMMER COMPANY, Cleveland, Ohio.

JESSOP'S STEEL For TOOLS, DRILLS, DIES, &C.
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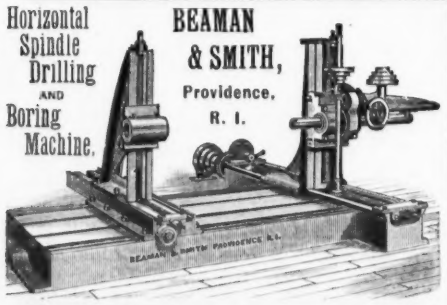

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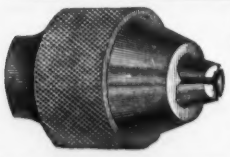

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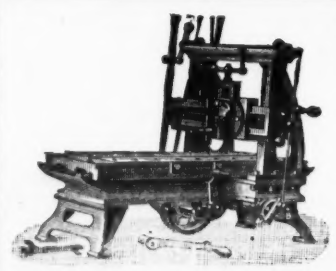

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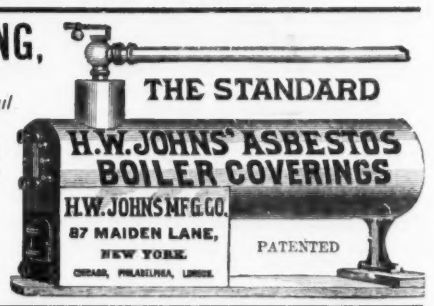

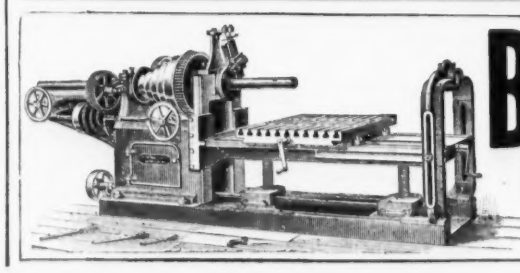

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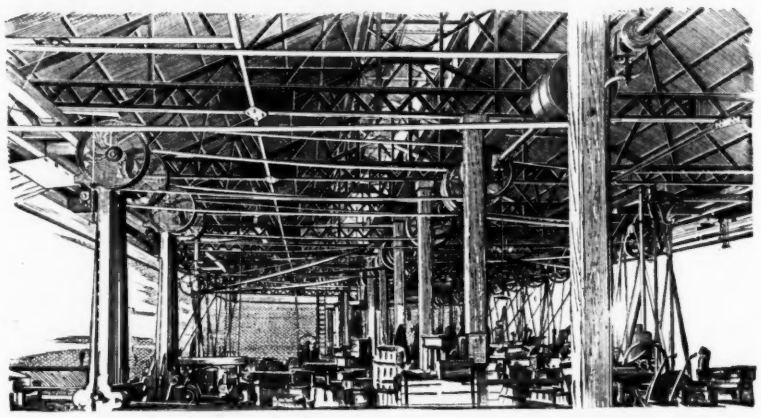

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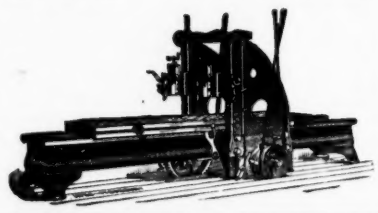

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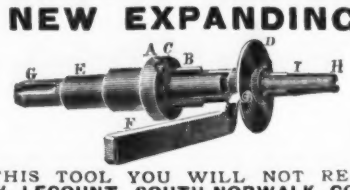

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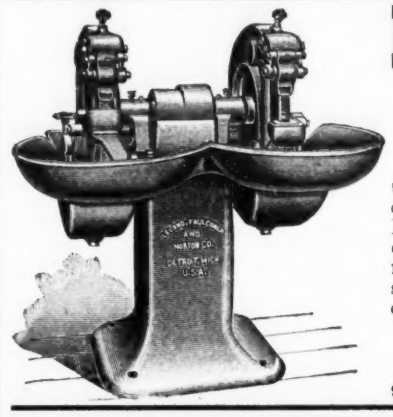

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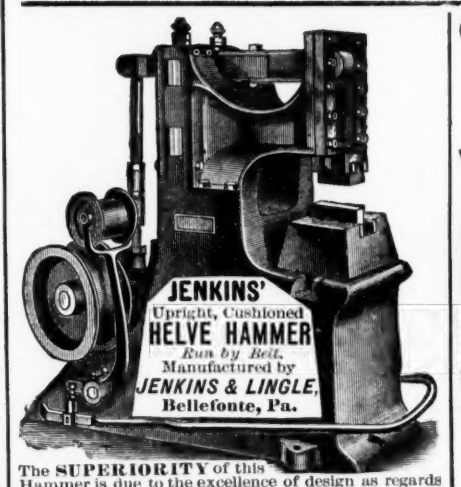

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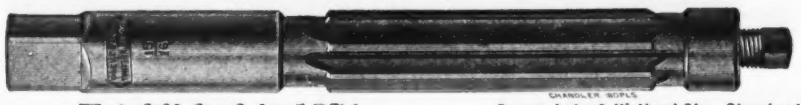

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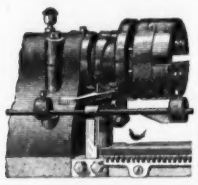

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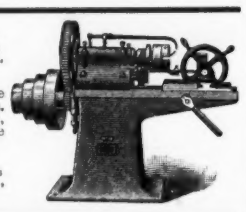

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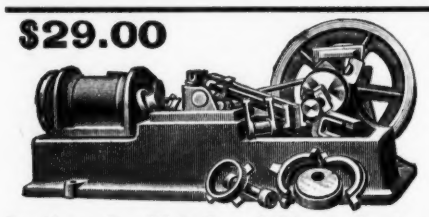

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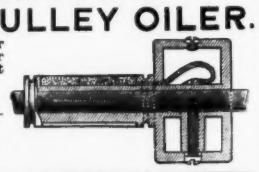

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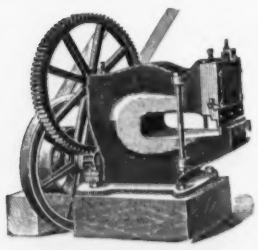

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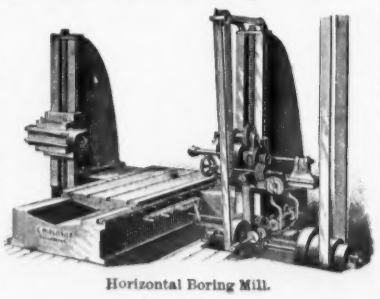

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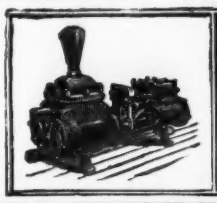

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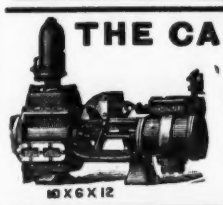

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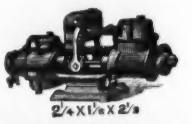

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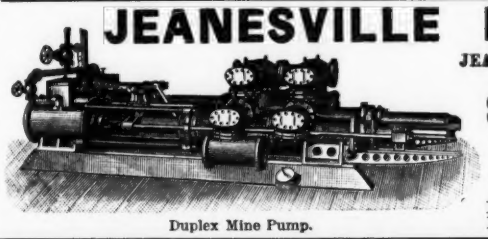

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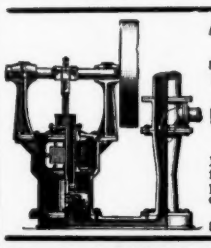

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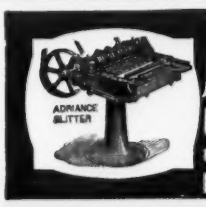

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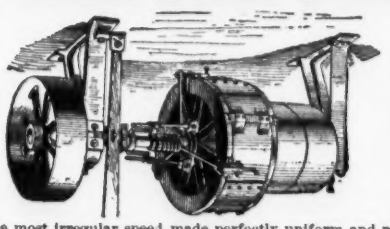

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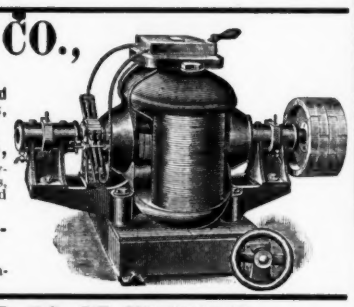

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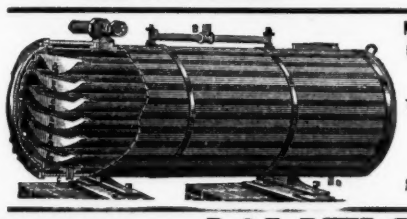

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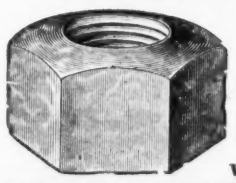

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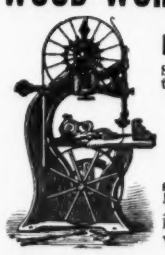

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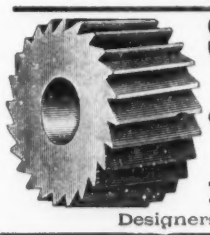

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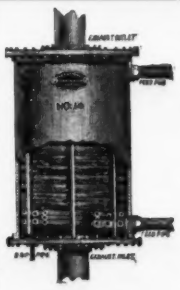

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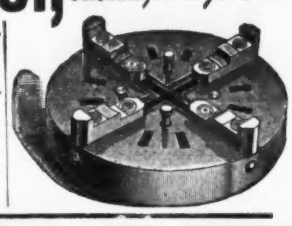

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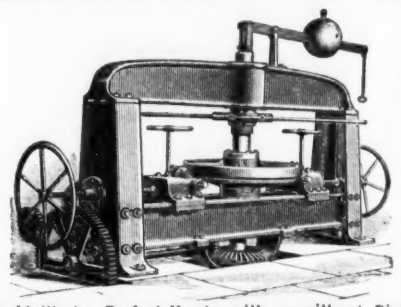

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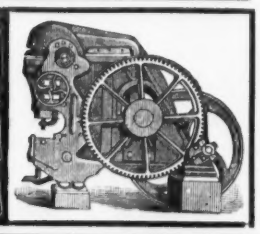

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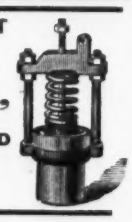

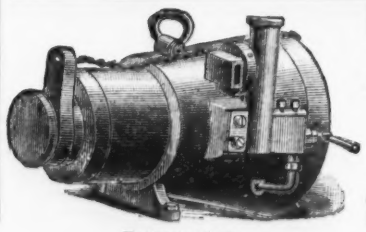

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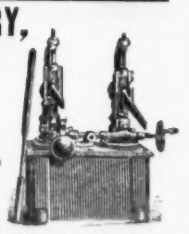

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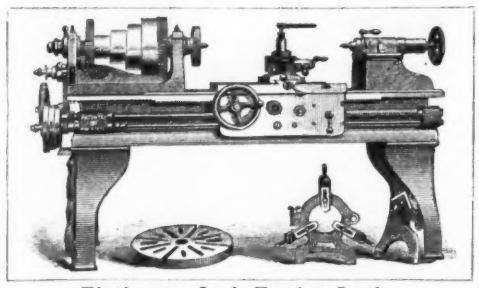

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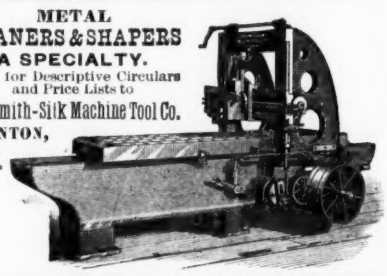

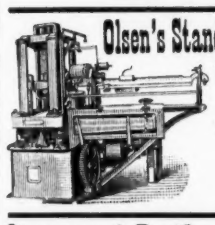

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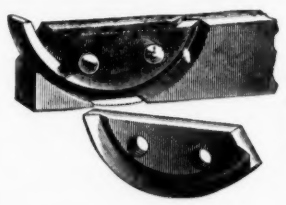

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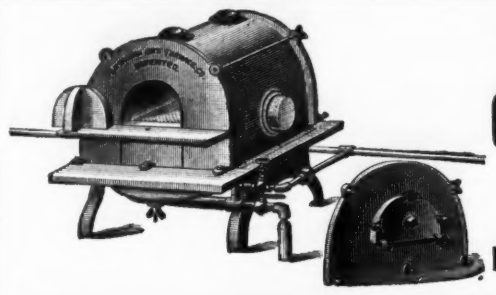

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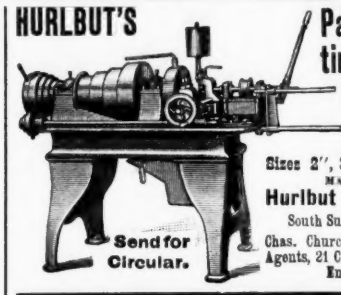

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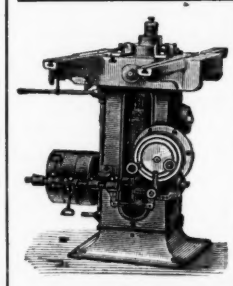

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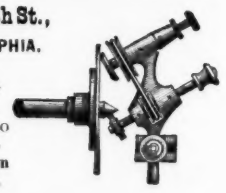
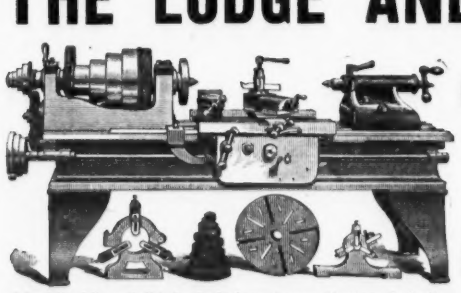


THE LODGE AND DAVIS MACHINE TOOL CO.

Works, CINCINNATI, OHIO.



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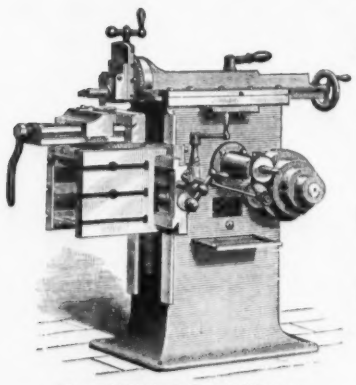
14, 16, 18 and 21-Inch Swing, Large Hollow Spindle.
Taper Attachment, Automatic Stop, Compound Rest, Lead Screw, under front V. All feeds reversed in apron.
Extra heavy, Convenient, and easily handled.

24, 27, 30 and 38-Inch Swing, Cabinet Legs.

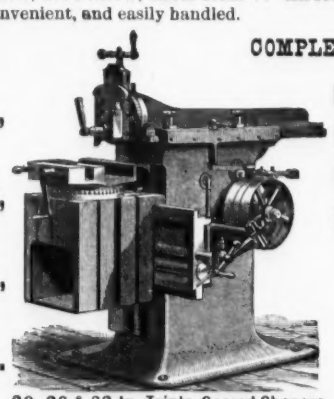
CABINET TURRETS, AUTO. MONITORS, FOX MONITORS, SPEED LATHES, &C.
COMPLETE BRASS WORKERS' OUTFITS.

COMPLETE MACHINE SHOP EQUIPMENTS A SPECIALTY.



ENGINE LATHES,
TURRET LATHES,
PULLEY LATHES,
CHUCKING LATHES.

15 and 20-Inch Crank Shaper.
Stroke changed and adjusted while running. Stroke at all times positive.
Invariably plane to a line.
Detachable Tables.



20, 26 & 32-In. Triple Geared Shapers.
Stroke changed while machine is running. Shaft can be passed through head of machine and key seat cut in same to any length. Extra heavy vises. Tables slotted on all sides.
Special 26-In. Shaper with auto. down feed.

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MILLING MACHINES,
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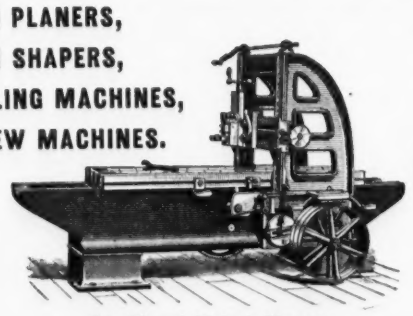

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Extra deep beds and tables. Powerfully geared. Plenty of Metal and designed for extra heavy duty. All Feeds and Shipper operated from both sides.
Improved device for holding Planer Bolts.

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DRILL PRESSES,
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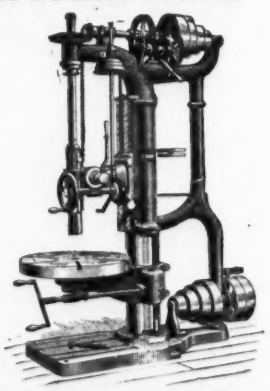

25, 28, 32 and 40-Inch Drills.
Automatic stop to feed. Quick return on right side. Table operated from front. Large cones and long belts.

See Advertisement on Page 20.

MORSE TWIST DRILL AND MACHINE COMPANY,

Manufacturers of Morse Patent Straight-Lip Increase Twist Drills. New Bedford, MASS.

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

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Also Hand Lathes, Foot Lathes and Milling Machines.

FLATHER ENGINE LATHES.

14, 15, 16, 18, 20, 24 and 28 INCH SWING.
ANY LENGTH OF BED DESIRED.

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Manufacturers of
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Lathes from 10 in. to 20 in. swing. Largest Variety of Drills manufactured in the world.
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15" and 18" Crank } SHAPERS.
20" and 26" Geared }
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PATENT FRICTION SHAPER.

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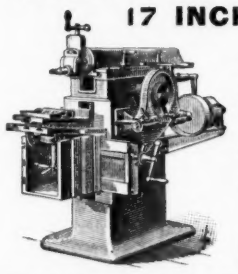

Double racks allowing shaft 2⅛ to pass through base. Adjustable table for taper work, swivel jaw vise, feed adjustable while running, driven by hardened steel worm in phosphor bronze wheel.
Weight, 1300 lbs.
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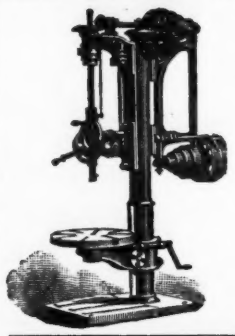
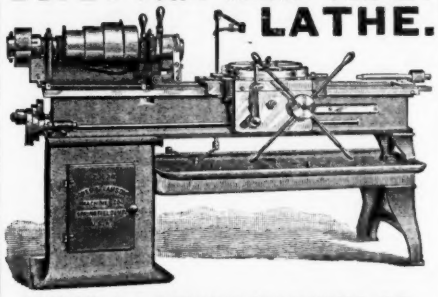


Lathes,
Planers,
Shapers,
Slotters,
Etc.

---

2 BY 24 TURN TABLE TURRET LATHE.



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Manufacturers of and Dealers in
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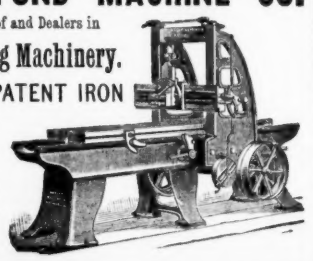

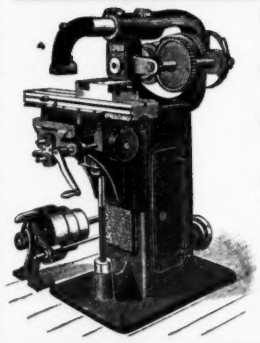

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Plain Back Geared Milling Machines.
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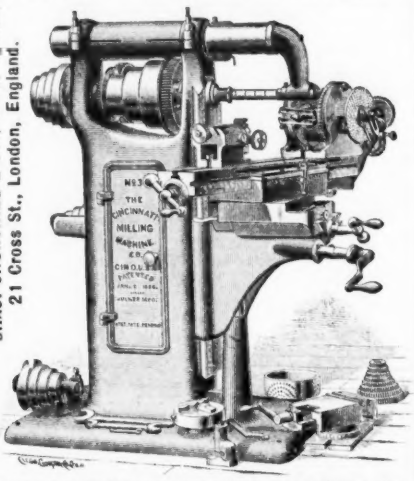

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Established 1850.

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BUILDERS OF
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FOR
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20 Inch Drills,
With latest improvements, Lever, Combination or Wheel Feed, address
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The Garvin Machine Co.,

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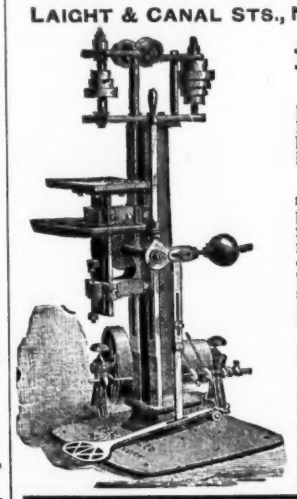
Machinists' Tools,
Including Milling Machines, Drill Presses, Hand Lathes, &c.



The machine shown in cut is especially designed for jobbing, and is fitted up with one or two spindles. Those with two spindles have pulley, with two sections, which gives two speeds to each spindle. Those fitted up with one spindle have a cone pulley with three sizes. The back shaft has a cone pulley with four sizes.

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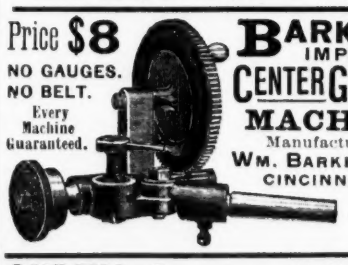

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PIPE CUTTING AND THREADING MACHINERY For Hand or Power.
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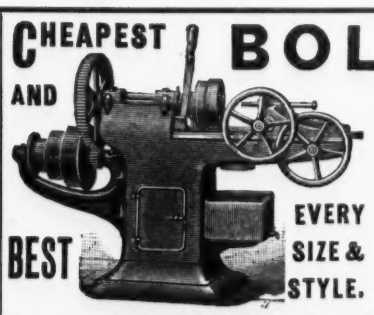

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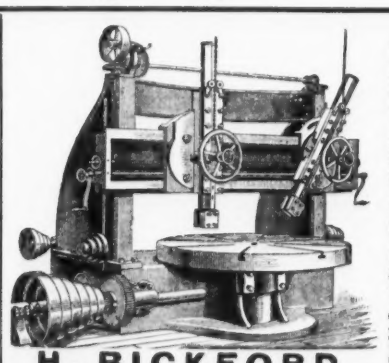

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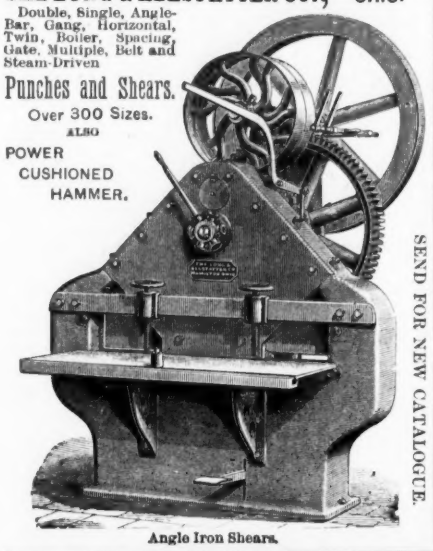

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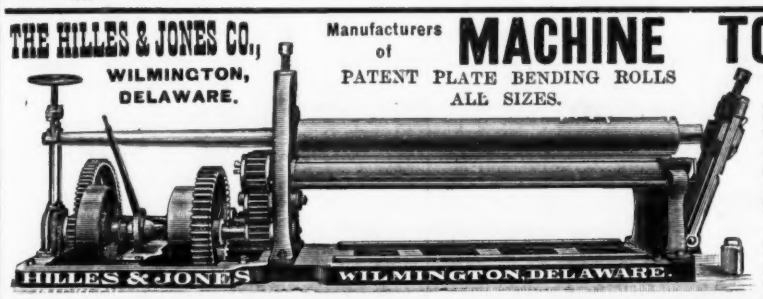

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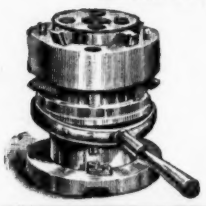

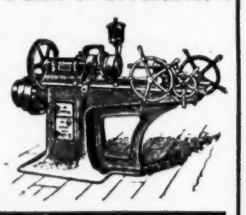

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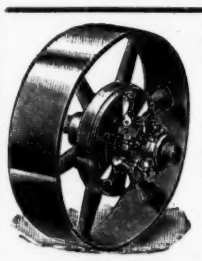

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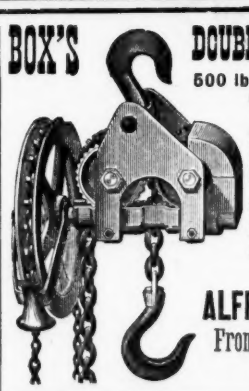

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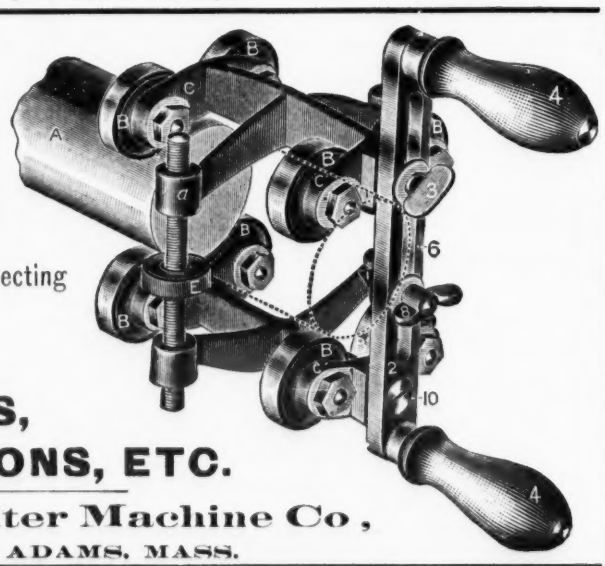

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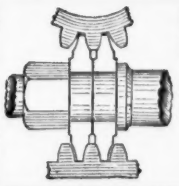

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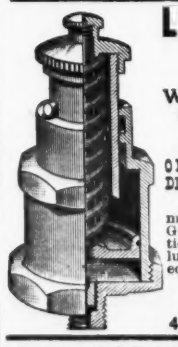

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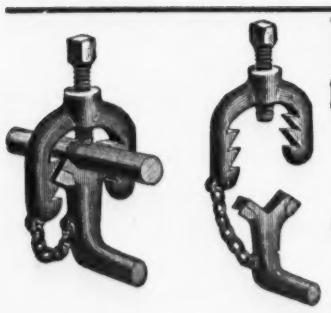

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One Set of 3 does the work of 12 common dogs.
No. 1, ¼" to 1¼"; No. 2, ½" to 2¼"; No. 3, 1" to 3¼".
$7.50 Per Set.
These DOGS can be attached after the work is centered in the Lathe.
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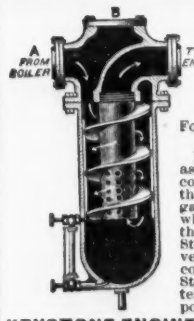

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Simpson's Centrifugal Separator and Trap.
For Supplying Clean and Dry Steam to Engines, Dry Houses, etc.
Place Separator as close to engine as possible, the steam taking a spiral course between the threads causes the water to be thrown by centrifugal force against the outer walls, while the dry steam goes through the small holes to center of pipe. Steam can enter at A or B, as convenience may require; also used in conveying steam long distances, for Steam Hammers, Dry Houses, Water Gas Generators, and for all purposes where Dry Steam is necessary.
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DELIVERS
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To your engine or for any other purpose, no matter HOW LONG YOUR STEAM PIPE, or how much your BOILER MAY PRIME. An absolute safeguard. A source of economy.
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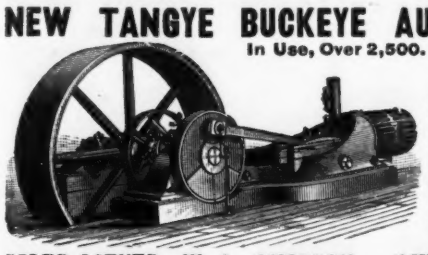

These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for Driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

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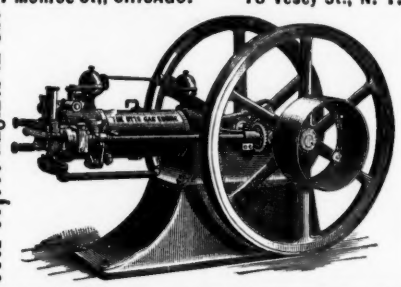

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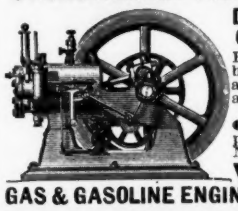

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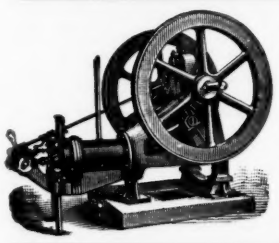

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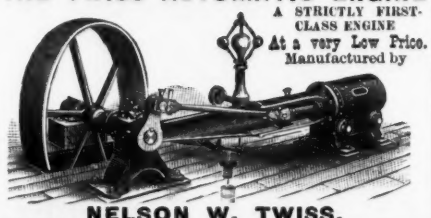

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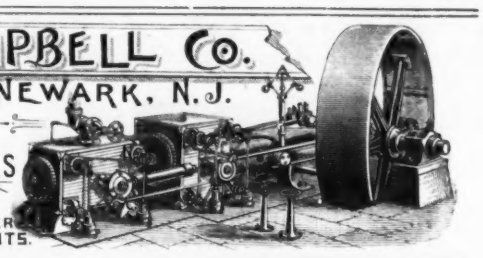

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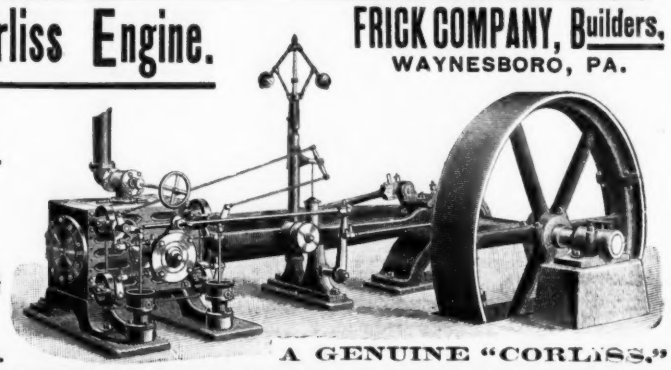

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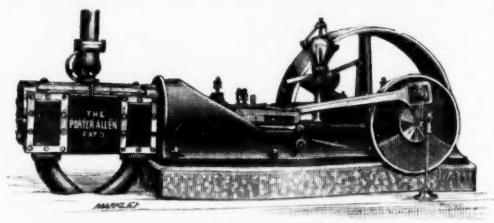

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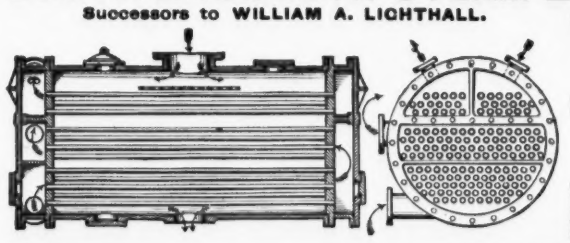

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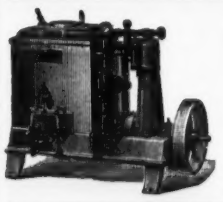

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WITH GRADUATED BASE FOR USE UPON

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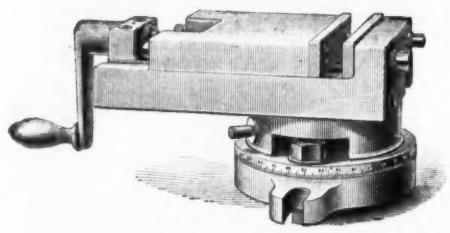

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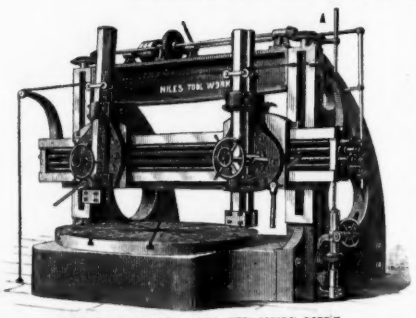

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JENKINS every valve tested and warranted, all parts interchangeable.
Nothing but best Steam Metal used in the manufacture.
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Bolts used only in the Jenkins Bros.' Valves.
Genuine are genuine unless stamped with "Trade Mark."
Should you order INSIST on having Jenkins Bros.' Valves.

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THEY GET THE REWARD.

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A perusal of all the answers to our advertisement proves conclusively that the American people are great readers and possess a wonderful amount of originality.

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EBERHARDT'S PATENT.
With rare exception, this machine is cutting ALL

ELECTRIC MOTOR GEARS
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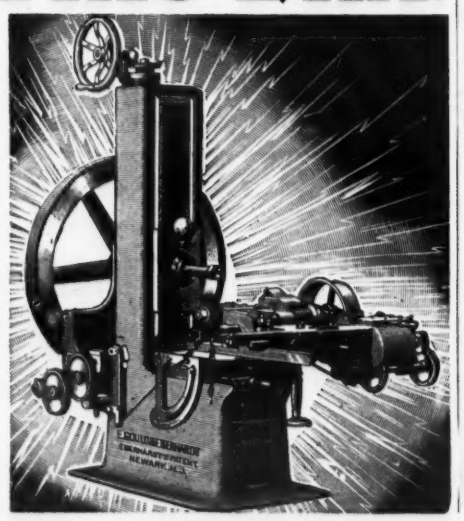

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With 6 in. x 10 in. stroke.

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With 12 in. and 14 in. stroke, all feeds automatic.

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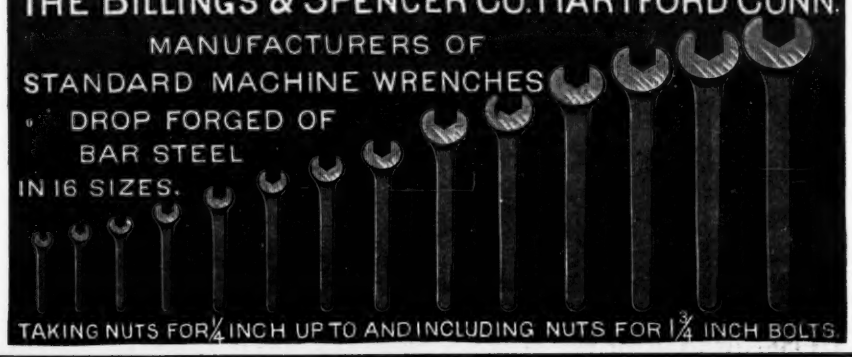
DROP FORGED OF
BAR STEEL
IN 16 SIZES.



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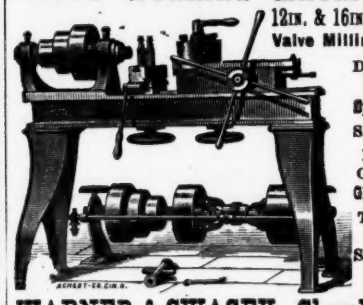

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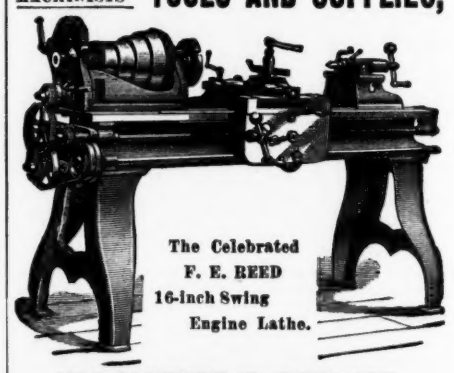

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FROM 16 to 48 IN. SWING.
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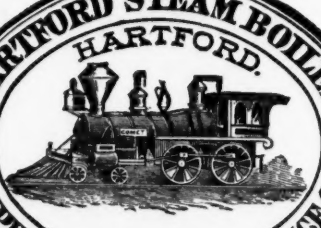

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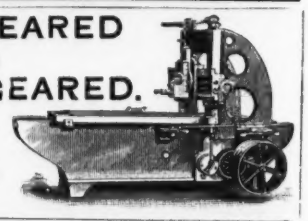

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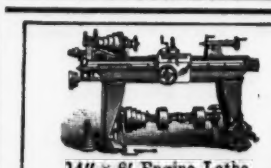
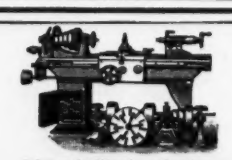


14″ × 6′ Engine Lathe.



16″ × 6′ Engine Lathe.

21″ × 8′ Engine Lathe.

THE HENDEY MACHINE CO. SEND FOR OUR CATALOGUE. MANUFACTURERS OF MACHINE TOOLS TORRINGTON CONN.

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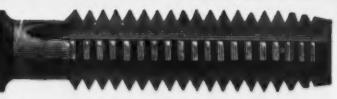
PAWTUCKET.R.I.



Manufacturer —of— TAPS & DIES